

# Design Engineering

1959 V5 #1, 3-6

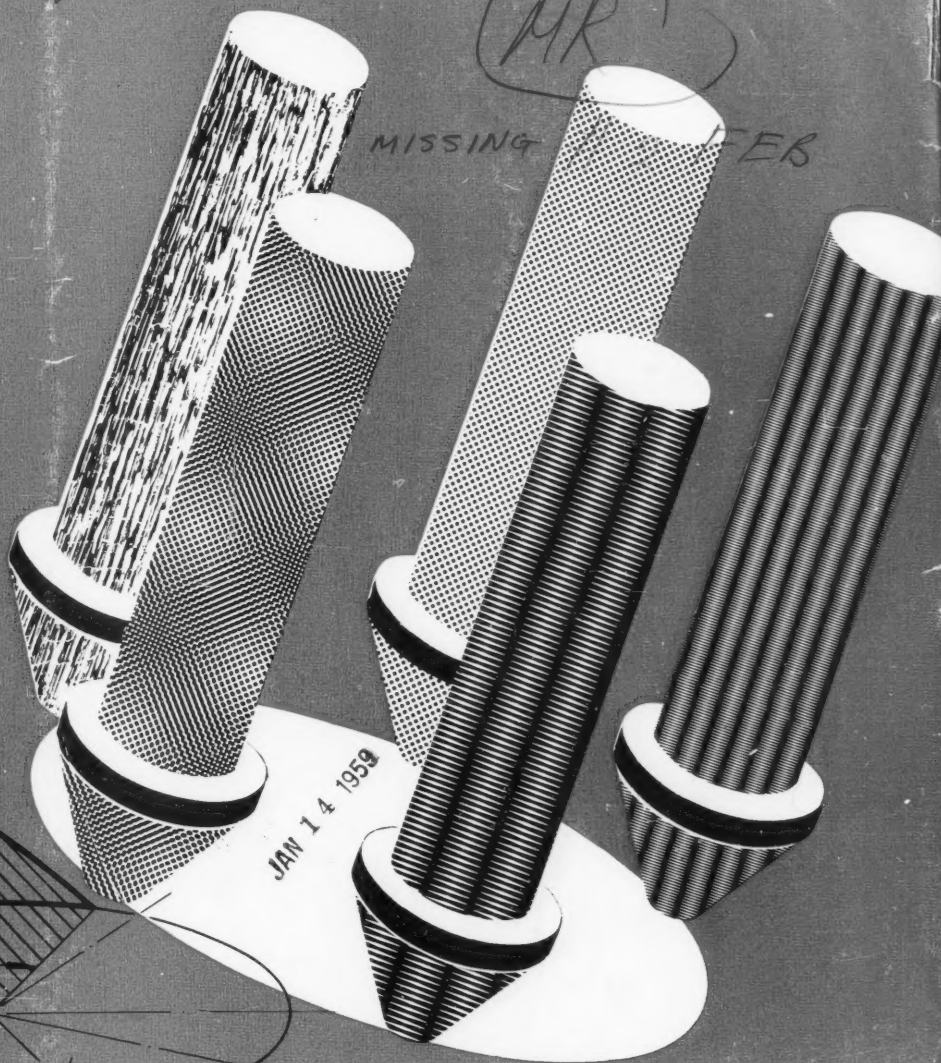
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**Control valves ..... p30**

**January 1959**

**Pneumatic circuits ..... p36**

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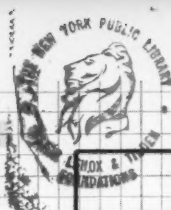
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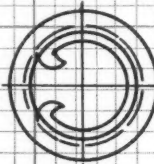
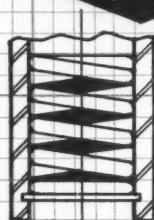
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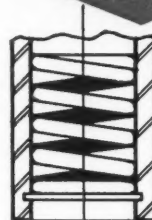
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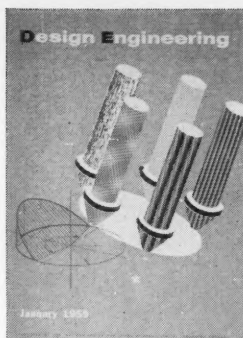
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# Design Engineering

Vol. 5

JANUARY 1959

No. 1



## This month's cover

It's an exploded view of the piston pumps and upper thrust bearing, with the thrust components indicated for a five-piston pump. Artist Gerald Bern almost exploded too when he saw the complicated equations of the axial pump article . . . but survived to do a bang-up cover to start the New Year.

## Design Engineering

MEMBER

CCAB

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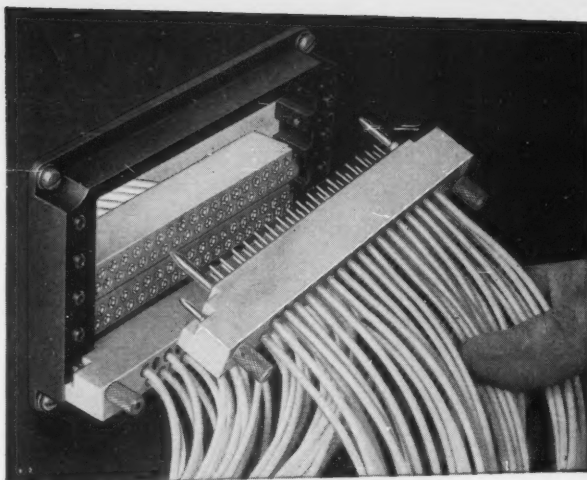


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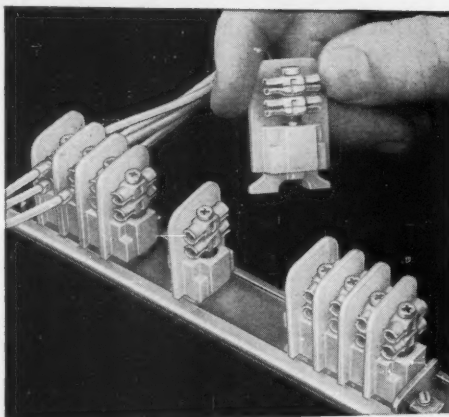
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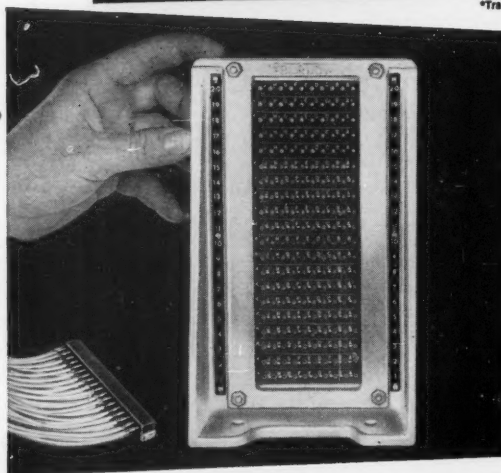
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Norman M. Wickstrand is with the Torrington Company, Torrington, Conn., as the mathematician in the bearing engineering department. He joined the company in 1954 and has had over 25 years experience in the anti-friction bearing industry. He has an SB degree in mechanical engineering from Massachusetts Institute of Technology, is a registered professional engineer and lecturer in mathematics at the University of Connecticut. Exercising his mind for a living, he stretches his legs for his hobby (hiking) and enjoys all the wonders of botany.

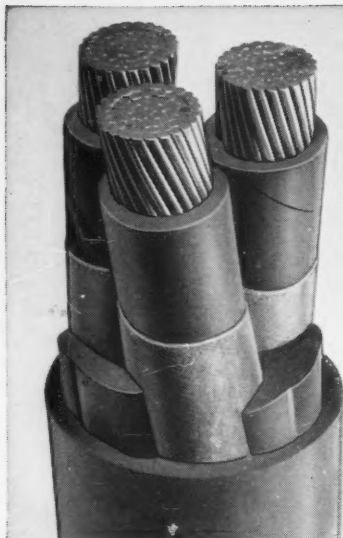


Herbert Gailey author of the article on page 36 has a broad background in the field of pneumatics. Before joining the Ross Operating Valve Company, Detroit, Mich., he had gained extensive experience in all types of production engineering. Gailey joined the Ross organization in 1950 as chief inspector and process engineer, and later became assistant chief engineer in charge of research and development. At present, he is in charge of the applications engineering division.

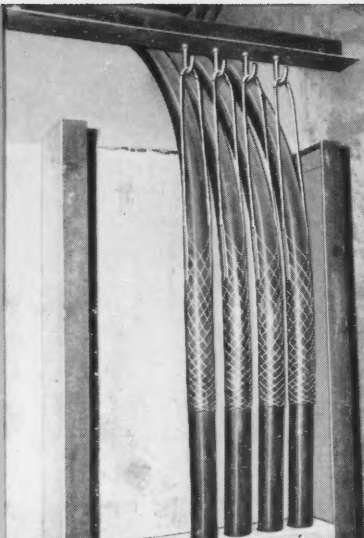


Donald F. Collins is chief engineer of the aircraft and missile fittings division of Parker Aircraft Company, Los Angeles, Calif. He is presently engaged in the development of special tube couplings and fittings for high pressure and high temperature service. Collins joined Parker in 1957 as project engineer in the check valve and fittings division. Before that, he was resident engineer for the Weatherhead Company, Glendale, Calif. Professional affiliations include the Institute of Aeronautical Sciences and SAE.

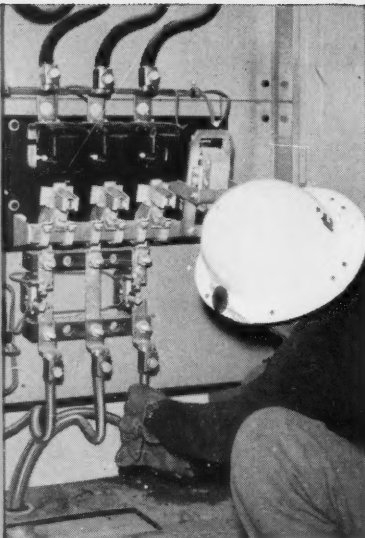




**The Polysar** Butyl-insulated low voltage cable built by Pirelli Cables is a 3-conductor 600 MCM power cable operating at 600 volts.



**Parts** of the cable installation were vertical runs, for which the above special suspension system was developed.



**As the cable** reaches this control panel its three conductors are connected to separate circuits. Polysar Butyl-insulated cables are easy to install and terminate.

## Polysar Butyl gave Pirelli the answer to exacting needs

**To carry power** to elevators, pumps and lighting equipment at the Robert H. Saunders—St. Lawrence Generating Station near Cornwall, Ontario Hydro specified a cable insulation which could withstand the high temperatures generated by heavy loads and have a long life expectancy.

\*Polysar Butyl was the insulation chosen to meet these specifications by Pirelli Cables Conduits Ltd., the successful tenderer.

Excellent ozone and moisture resis-

tance and ease of installation of the finished cable were further advantages which made Polysar Butyl the preferred insulation material.

Pirelli custom-built 16,000 feet, three-conductor 600 volt power cable. Each conductor is insulated with heat and ozone-resistant Polysar Butyl.

This important cable installation provides another practical example of the superior insulating qualities of Polysar Butyl.



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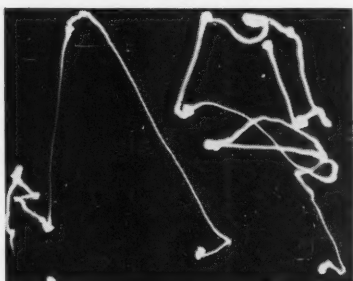
**This was** the lower reach of the famous Long Sault Rapids before the river was diverted to provide a vast reservoir with an 81 foot head of water. The Robert H.

Saunders St. Lawrence generating station is shown during an early stage of construction. The station will have 16 generating units with a total capacity of 820,000 kilowatts.

# Reports

**A news roundup of items of engineering and design interest from the world over**

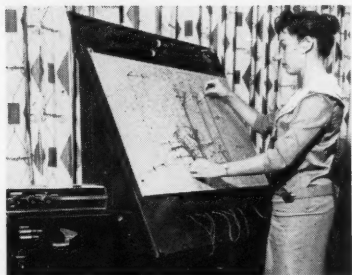
## Flashlight on fingers point to less fatigue



Competitive tests on lapsed time and hand travel requirements when using the conventional T-square as compared to a modern drafting machine have been made recently.

The study was conducted by Charles Bruning (Canada) Ltd. and revealed many interesting facts. The unretouched photograph at left shows the few hand movements needed when drawing a simple trapezoid with all angles in even 15 deg multiples. Pen lights were taped to each draftsman's hands and a time exposure of the process made in a darkened room. A stopwatch timed the drawing operation. Result: the mechanical aid did the job  $2\frac{1}{2}$  times faster with one quarter of the hand movements.

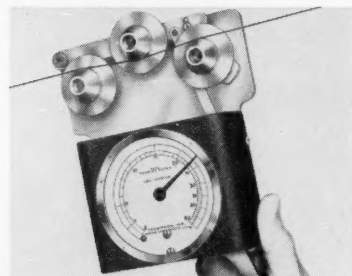
## Complicated jobs become easier with AIMO



Eyes off the pretty girl, gents, and let's get down to business. Observe the wire from the model's earphone trailing down over her arm to a fitting (like a fancy buckle) on her belt?

Now see the box at extreme left of photo. These three units are part of AIMO (Audio Instructed Manufacturing Operation)—a new way of conveying instructions to workers. It might even make blueprints and written instructions generally obsolete. Two Dictaphone machines do the chores. One records the information needed to tell the worker how to do the job. The other machine reproduces these prerecorded instructions for the operator performing the duty. "Blocks" of information can be repeated.

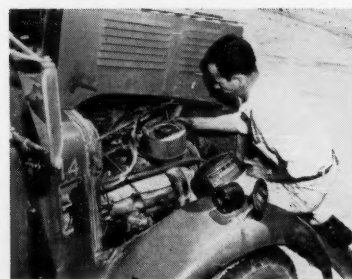
## No production slack-off with tension tester



A smiling reception by production managers is predicted for this new tension meter. Makers (Tensitron Inc.) say it has a range of up to 50-lb on yarns, wires, sheets, and other filamentous and flat materials. Their punch line is that it can be used on the production line.

The meter features a novel lever inserting mechanism—both outer rollers (see photo) being lowered simultaneously. This opening permits material to be placed between the rollers; moving the lever in the opposite direction puts the material in a test position. A model can be made with flat, one-inch rollers for testing cloth, paper and plastic.

## Dry type air filter rescues fleet profits



Down in Baltimore recently, a fleet of 14 dump trailers was wheezing to a halt every two weeks—right in the middle of a hefty work schedule.

The trailers were hauling 500 tons of excessively dusty fertilizer more than 500 miles in one week. Under these conditions the carburetor metering tubes were getting as congested as a boy smoking his first fag. Application engineers from Purolator Products, N. J., were called in and said the solution was in replacing the oil bath filters with micronic, dry type air ones. It was—and the fleet owner is now happily smoking cigars without so much as a trace of a schoolboy wheeze, according to reports.



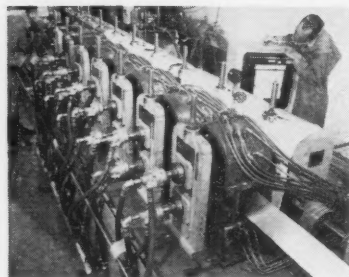
## Did you remember to water the diamonds, Mabel?



It looks like that could very well be the next step in this wonderful world of ours. A few days before going to press, we were told about a pilot plant production of synthetic quartz crystals for telephone communication purposes.

A lovely girl might like to get her hands on diamonds this size, but the crystals shown here are synthetic quartz grown at one of the Western Electric Company's works. These crystals will replace the natural quartz ones obtained mainly from Brazil for Bell Telephone's communication equipment. Synthetic quartz is produced by the hydrothermal process and a growth rate of 60 thousands of an inch per day achieved.

## Titanium alloy formed by enclosed heating



The photograph at left shows titanium high-strength alloy being formed successfully on a modified Yoder Roll at the Boeing Airplane Company. Enclosed heating is used to reach the required forming temperature.

Furnaces enclose each individual set of rolls and each encircling furnace has 18 burners around its periphery. To prevent bearing trouble, hollow shafts have been installed through which cooling water circulates. Pre-mixed propane gas is used as fuel. Tests have been made at a rolling speed of 1½ ft per minute and a 32-ft strip has been rolled — though eight-foot strips are more generally produced.

## Radar simulator provides six targets

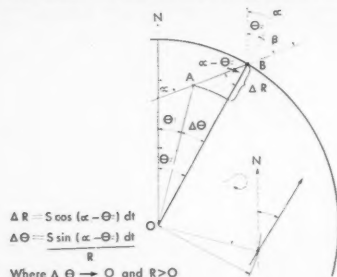
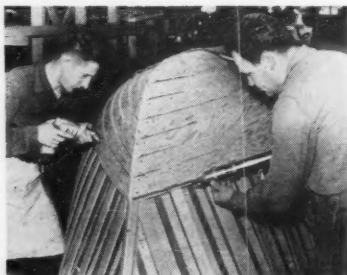


Chart shows the operation of the Curtiss-Wright model 57-9 six-target, two-dimensional radar simulator — primarily designed for training personnel. It is based upon a direct Rho-Theta co-ordinate method for generating rates and positions.

In plotting a course across the screen in Rho-Theta co-ordinates, the varying quantities are the incremental change in range and the incremental change in bearing between the sweeps of the radar screen. To derive these quantities, a heading resolver is provided with voltage input representing the speed of the simulated aircraft. The relative position of the rotor and stator of this resolver is set to the angle representing the heading angle minus the bearing angle.

## Tough sealant keeps leaks out of pleasure craft



January is as good a time as any to revive last year's boating memories and look forward to new experiences.

The photograph shows a new type of nonshrinking, adhesive sealer being used to caulk planking joints on a clinker-built craft. This type of craft often develops leaks in the planking joints, particularly after the first season's use. Metal fasteners become loose when the wood contracts and some rubber sealants shrink when dry. Posed with this problem, the Adhesives, Coatings and Sealers Division of Minnesota Mining and Manufacturing Co., came up with a new elastic, high adhesion, water resistant sealer. It vulcanizes both sides of the planking seams so that the hull becomes a one-piece structure.

## More British television cameras for Canadian studios



A 4½-in. image orthicon tube is fitted into a Marconi Mark III television camera — one of six recently shipped to the new CBC studios in Montreal and Toronto.

These studios will each contain four of the cameras initially, but room has been left for further expansion. The camera control units will be fitted with adapter boxes suitable for use with both Mark II and Mark III cameras. These latter can be used with either 3-in. or 4½-in. image orthicon tubes—the larger size being notably free from spurious edge effects. It has also an exceptionally good signal to noise ratio. English Electric Valve Co. make the orthicon tube.

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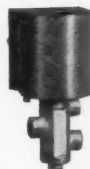
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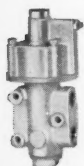
**3-Way  
Pilot  
Operated**  
1/8" - 1"



**3-Way  
Cam  
Controlled**  
1/8" - 1"



**3-Way  
Direct  
Solenoid**  
1/8" - 1"



**3-Way  
Sequence  
Time-Delay**  
1/4" - 3/4"



**3-Way  
Solenoid  
Pilot**  
1/4" - 1"

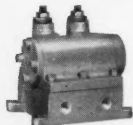


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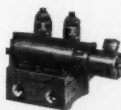
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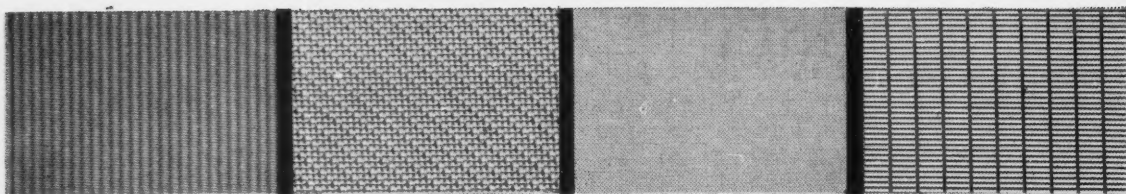
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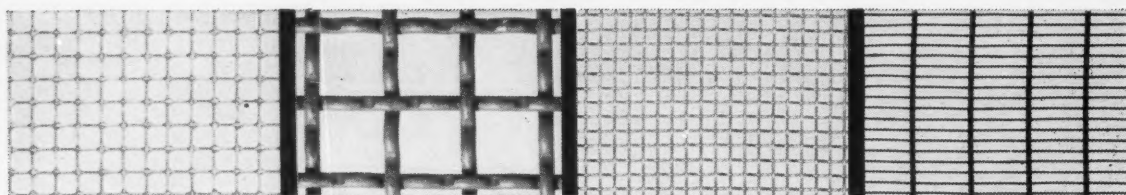
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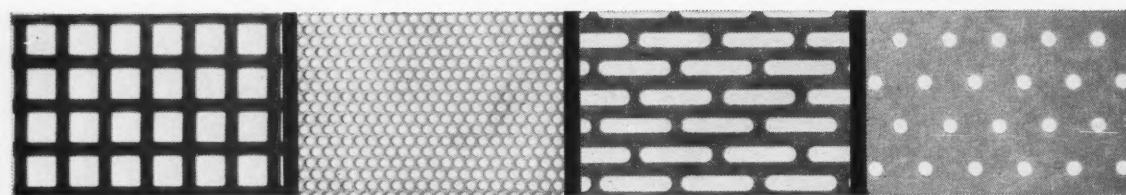
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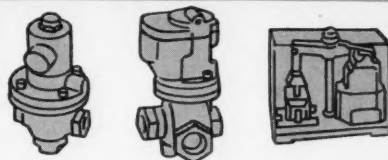


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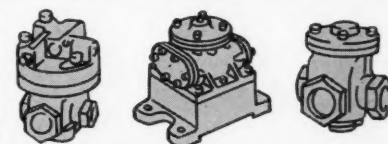
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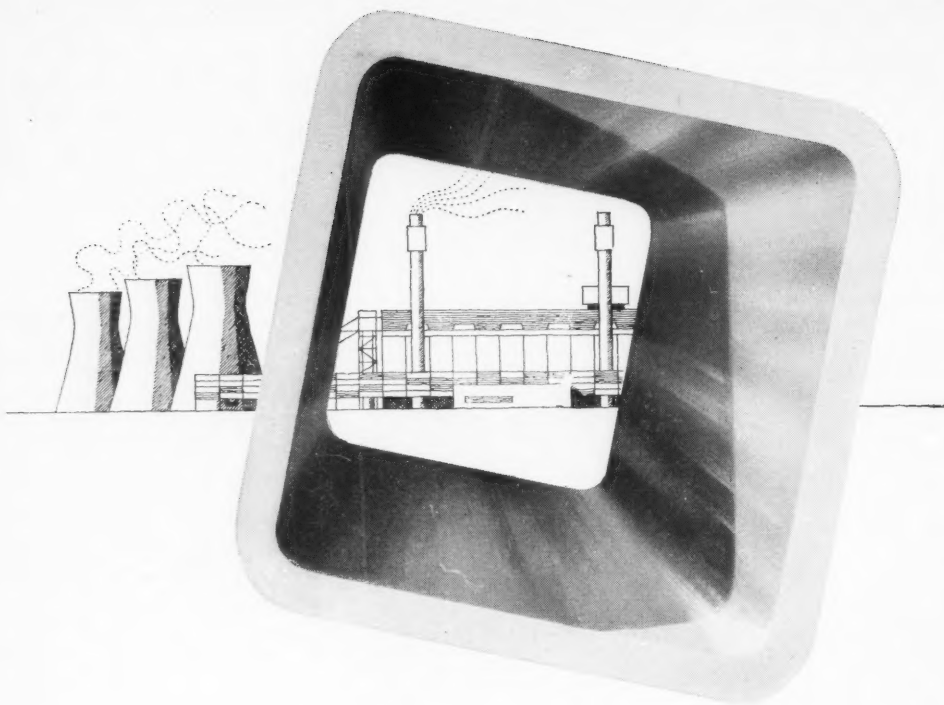
control single or double acting cylinders. Virtually every type can be supplied for either in-line or base mounting. Ross gives you complete flexibility.

# Ross

**OPERATING VALVE COMPANY**

162 EAST GOLDENGATE AVE., DETROIT 3, MICH.





# WHAT'S IN A TUBE?

In every Chesterfield tube there is a lot of experience that doesn't show on the surface. Whether we are drawing a header for the boiler of a power station or turning out a miniature gas bottle to inflate a life-jacket, we make use of manufacturing techniques and individual skills that have taken anything up to 50 years to perfect. There is no substitute for the experience that goes into ***chesterfield tubes.***

THE CHESTERFIELD TUBE COMPANY LIMITED • CHESTERFIELD • ENGLAND • A  COMPANY

Canadian Representatives: STANDARD TUBE AND T.I. LIMITED, WOODSTOCK • HAMILTON • TORONTO • OTTAWA • MONTREAL  
CRC 60

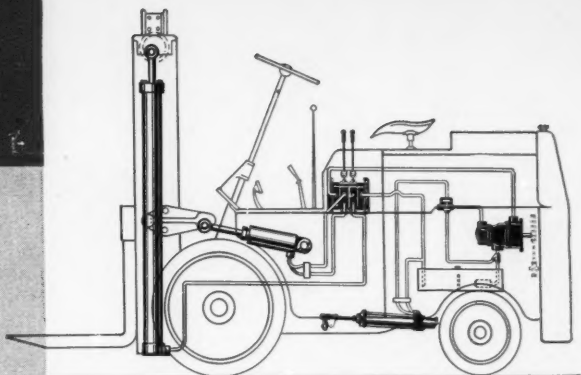
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# VICKERS

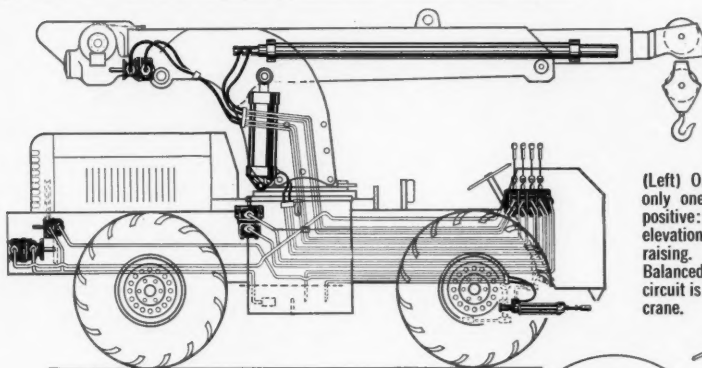
HYDRAULIC SYSTEMS

**Designate Superior Materials  
Handling Equipment**

"Nobody sets a diamond in a brass ring." And when a manufacturer of materials handling equipment uses Vickers Hydraulics, it is indicative of superior quality throughout. To the inherent advantages of hydraulic control, Vickers adds the benefits of a nation-wide and full time field engineering and service organization of unequalled experience. Vickers has the complete line of hydraulic equipment necessary to take undivided system responsibility . . . to eliminate any risk of incompatibility of hydraulic components. For further information, ask for new Bulletin M5101A.

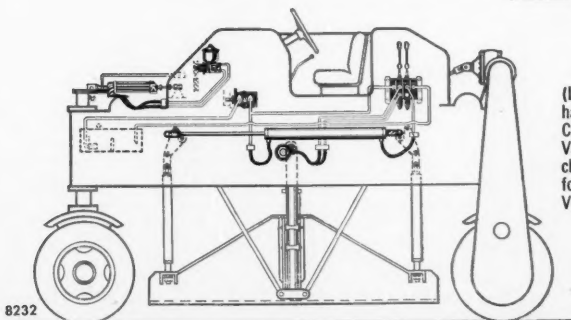
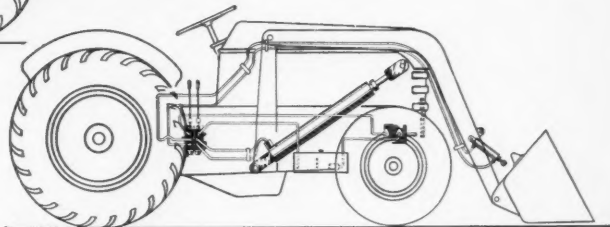


(Above) Fast tilting and lifting are possible along with exclusive "feathering" ability. Also, fingertip power steering permits operator to maneuver vehicle with one hand and control loading operations with the other. Additional vehicle attachments can be hydraulically controlled by simply adding sections to existing control valve eliminating necessity of mounting separate valves.



(Left) One Vickers Hydraulic System (using only one pump) provides fast, smooth and positive: (1) turntable rotation, (2) boom elevation, (3) boom extension, and (4) load raising. Turntable is driven by a Vickers Balanced Vane Type Fluid Motor. Another circuit is used for power steering this hydraulic crane.

(Right) Fast, easy and dependable operation of front end loader depends upon Vickers Balanced Vane Pump and Vickers Two-Section Directional Control Valve. Automatic wear compensation is inherent in all Vickers Balanced Vane Type Pumps. Note simplicity of installation.



(Left) Straddle carrier uses hydraulic power to handle the load with precision and speed. Compact, two-section Vickers Multiple Unit Valve has double-acting valve for opening and closing load hooks and single-acting section for raising load. Separate circuit provides Vickers Hydraulic Power Steering.

8232

**WRITE FOR  
BULLETIN M5101A**

**VICKERS-SPERRY of Canada Ltd.**

**Division of Vickers Incorporated**  
SPERRY RAND CORPORATION

VANCOUVER—150 West 1st Ave. • TORONTO—92 Advance Rd. • MONTREAL—318 Victoria Ave.

**VICKERS OFFERS WORLD-WIDE FACILITIES—SALES AND SERVICE**

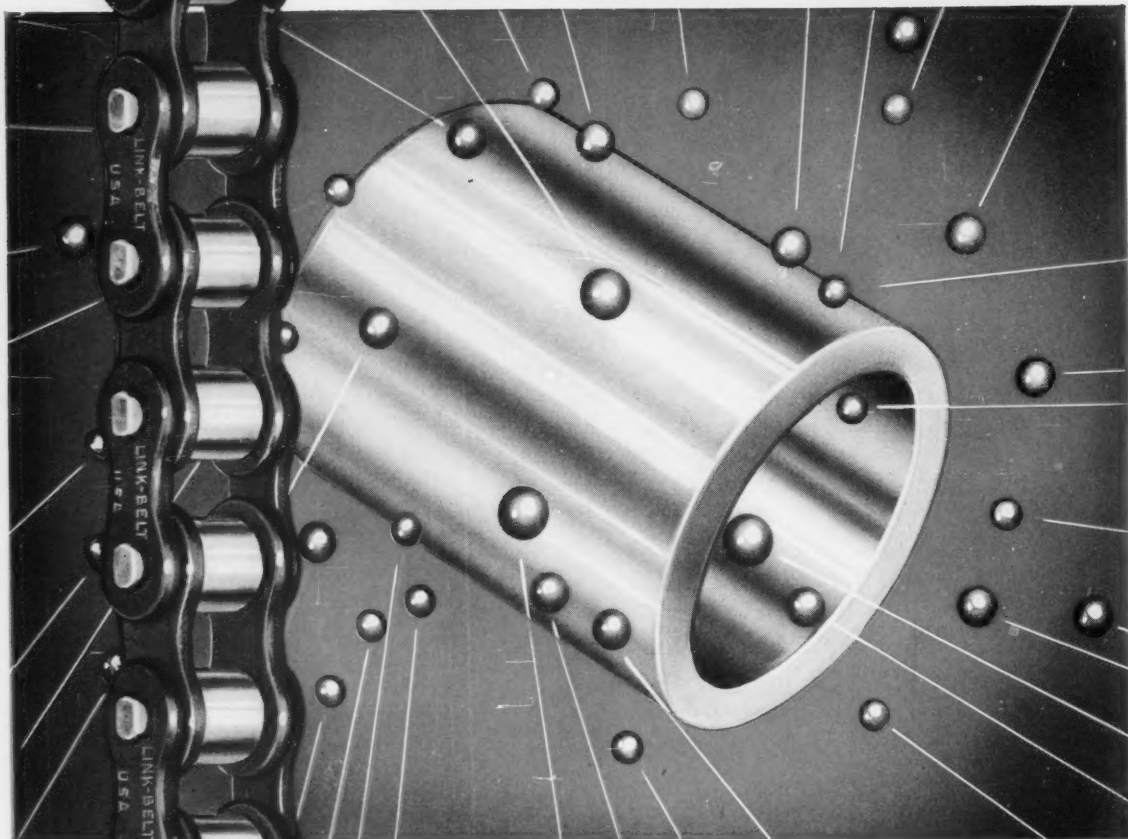
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Shining example of "extra" chain quality

# SILVER-BRITE

## SHOT-PEENED ROLLERS



### EXTRA LIFE IS POUNDED IN AND NOT POLISHED OUT

Rollers for Link-Belt precision steel roller chain are now finished by a special burnishing process to a "Silver-Brite" luster! And this is accomplished *without grinding away the benefits imparted by shot-peening*—a Link-Belt process that cold works the metal and provides extra fatigue life.

Many more special Link-Belt "extras" contribute to the dynamic strength so important for today's heavy loads and high speeds: close heat-treat control . . . lock-type bushings . . . pitch hole preparation . . . pre-stressing.

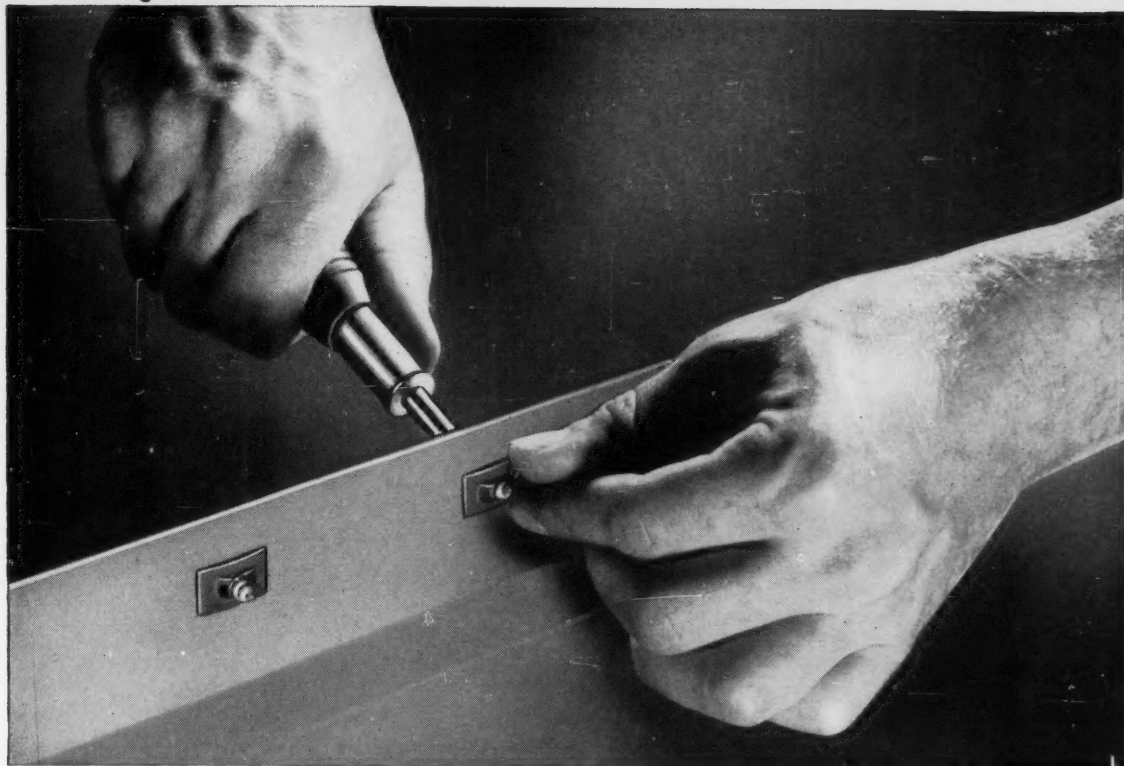
Ask your Link-Belt office or authorized stock-carrying distributor for new 154-page Catalog 2657—the most complete roller chain data book ever compiled.

# LINK-BELT



### ROLLER CHAINS & SPROCKETS

LINK-BELT LIMITED: Scarboro Plant, General Offices and District Sales — Dept. 159-DE, 1960 Eglinton Avenue, E., Scarboro, Ont., Station H, Toronto 13 • Eastern Avenue Plant and Factory Branch Store — Toronto 8 • Sales Offices and Factory Branch Stores — Montreal 15 • Vancouver 12 • Winnipeg 10 • Swastika, Ont. • Halifax: Austen Bros. Ltd. • District Sales Offices — Edmonton • Hamilton • Sydney: Austen Bros. Ltd. • Foundry at Elmira, Ont. 14,976-C



# These hands are your biggest investment

...they'll do better work  
faster with

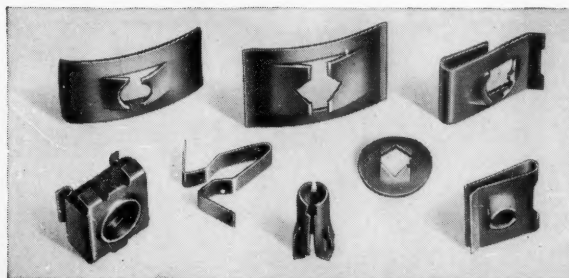
*Speed Nut*®

**FASTENERS**

*Manufactured in Canada*

In even the most mechanized plant, there is still a good deal of hand assembly to be done. It's vital to your profits that these hand operations be done quickly and expertly with no waste motions. To be sure that your big investment in these hands is paying a good return, look into Speed Nut Fasteners. These modern efficient fastening devices are cutting costs for thousands of leading manufacturers throughout the world. Mail this coupon today for complete information.

33-5802



## DOMINION FASTENERS LIMITED

a *Geo. A. Tinnerman* corporation

HAMILTON, ONTARIO. Branches: Toronto, Montreal.

*Exclusive licensee for Tinnerman Products Inc., Cleveland, Ohio.*

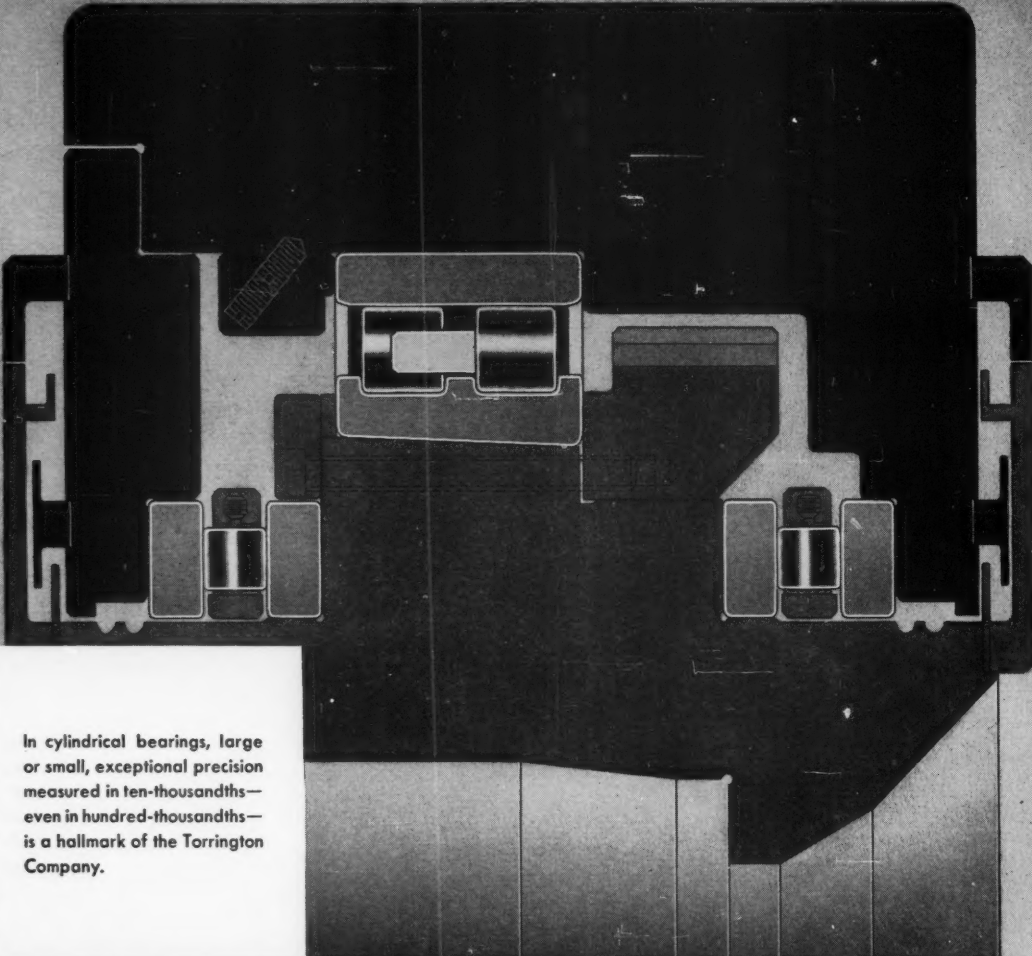
Please send me complete information on how Speed Nut Fasteners can reduce my costs and improve my product.

NAME \_\_\_\_\_

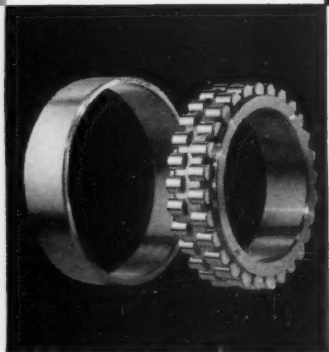
TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

WE MANUFACTURE \_\_\_\_\_



In cylindrical bearings, large or small, exceptional precision measured in ten-thousandths—even in hundred-thousandths—is a hallmark of the Torrington Company.



## *Turns true within three "tenths"!*

To the engineer, that means these large Torrington Cylindrical Roller Bearings have a total radial runout of only .0003"—three ten-thousandths of an inch! To anyone, that means ultra-precision.

These are spindle bearings custom-built for Gisholt Machine Company's center drive lathe. The tapered bore, two-row radial roller bearing is 44.2500" OD, capacity 189,000 pounds at 100 rpm. Face runout is held to .0005". Each of two cylindrical thrust bearings used is 38.4700" OD, capacity 105,000 pounds at 100 rpm. Diameter of rollers in any one bearing is held within one-half "tenth"—.00005".

This close approach to perfection is made possible by specialized equipment and superior workmanship, which go into the manufacture of every Torrington Bearing, large or small. Of course, not every application requires such ultra-precision. But each bearing requirement is given the extra measure of care that makes Torrington quality a byword in industry. **The Torrington Company, Limited, 925 Millwood Road, Toronto 17, Ont.**

## **TORRINGTON BEARINGS**

*District Offices and Distributors in Principal Cities of United States and Canada*

**SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • NEEDLE • BALL • NEEDLE ROLLERS • THRUST**

Circle number 142 on time saver card

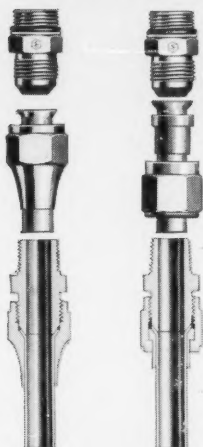


**your products deserve the best...**

# WEATHERHEAD

## STEEL TUBE FITTINGS

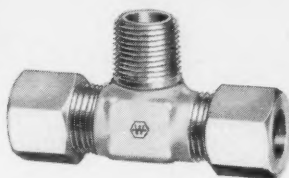
S.A.E. 37°  
FLARE-TWIN (J.I.C.)



2-piece

3-piece

ERMETO



Steel and stainless steel Ermeto fittings in sizes and types to meet any need. No flaring, threading, welding or soldering.

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STRAIGHT-THREAD  
ERMETO



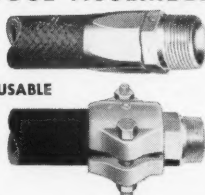
Straight-thread Ermeto tube fittings meet new S.A.E. Boss specifications. Closer coupling; higher P.S.I. with metal backup washers. New "Weathercote" finish for greater corrosion resistance.

## BULK HOSE AND ENDS

Any type of bulk hose and hose ends to meet any O.E.M. requirement.

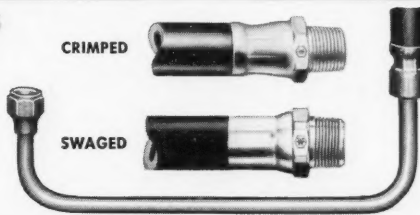
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REUSABLE



CRIMPED

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TUBE-HOSE ASSEMBLY

## BRASS FITTINGS



DRAIN AND  
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WRITE FOR FREE CATALOG



PIPE



SELFALIGN<sup>®</sup>



COMPRESSION



INVERTED  
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SAE 45°  
FLARE

Screw machine parts made to your specifications . . . any machinable material. Write for information.



# WEATHERHEAD

THE ORIGINAL EQUIPMENT LINE

The Weatherhead Company of Canada Limited

St. Thomas, Ontario

# *New* DAYSTROM-WESTON MULTI-POINT RECORDER

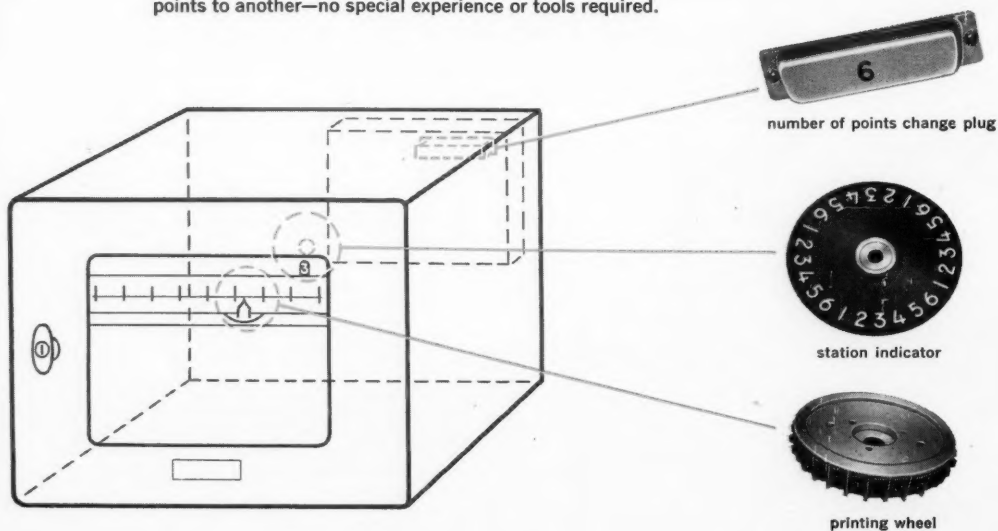
## *Introduces*

**INTERCHANGEABILITY**—from one number of points to another—one range to another—one chart speed to another.

**NEW LOW COST** — a single instrument: handling from 2 to 24 points! A single price: 15% less than the average multi-point!

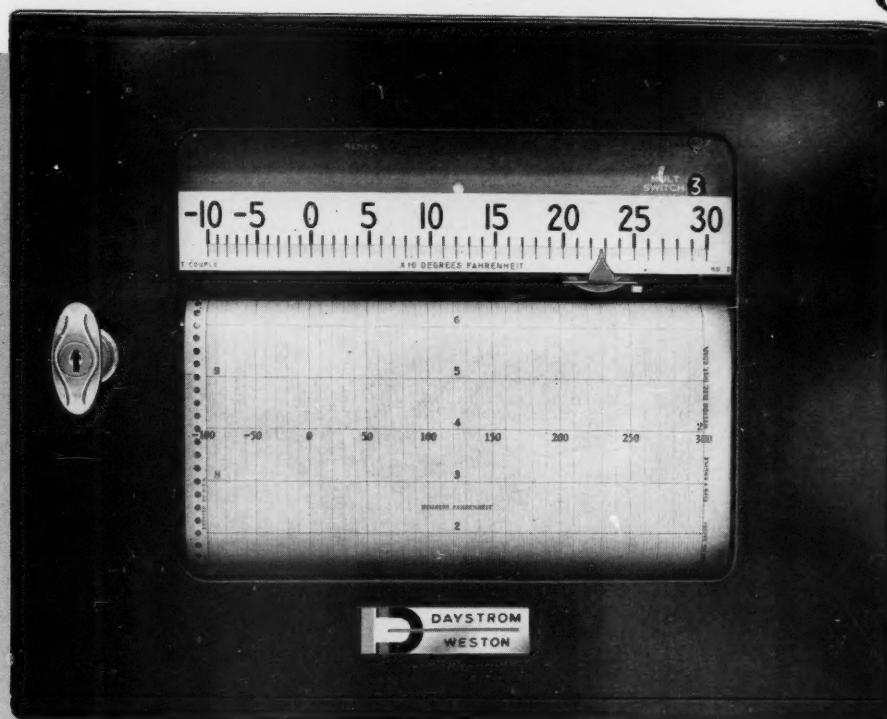
**39% SMALLER CASE** — with full-size chart and full  $\frac{1}{4}$  of 1% accuracy.

Here is all you need to change from one number of points to another—no special experience or tools required.



WITH

# UNITIZED *design*



**\* UNITIZATION:** the grouping of related components—in Daystrom-Weston Recording Potentiometers—in the simplest, most serviceable, most efficient manner.

There's tremendous value in this remarkably small instrument—thanks to Weston's *unitized design* and *unique pricing policy*. The size is a big dividend in itself, wherever panel space is at a premium. This is the most compact multi-point recorder—using a full-size chart, and of comparable accuracy ( $\frac{1}{4}\%$ )—ever available. Specially important: a single recorder, offered at a single low price, is easily interchangeable from one number of points to another . . . from one range to another . . . from one chart speed to another! It's so versatile it makes all other multi-point recorders obsolete!

There's none of the clutter or complexity you might expect in an instrument that serves as many functions as this. There's no jungle of wires to hamper inspection and maintenance. Every part is engineered for simplicity—which means trouble-free operation over the years. Components are kept to a minimum, and integrated into compact, rugged panels. Parts are actually more accessible than in much larger instruments.

The new Weston potentiometer recorder accommodates 2, 3, 4, 6, 8, 12, 16 or 24 signals. Changes in the number of recorded points can be made quickly and easily when desired. The unique etched circuit switch is geared directly to the printing head . . . can't get out of synchronization. And this recorder has all of the features that distinguish the other fine instruments in the Weston potentiometer line: simplified range changing with exclusive universal standards . . . high resistance to shock, vibration and corrosion . . . lowest spare parts inventory due to interchangeability of parts.

For more complete information on the Daystrom-Weston multi-point potentiometer recorder . . . the single-point recorder . . . or the recorder-controller . . . call or write to Daystrom Limited, 840 Caledonia Road, Toronto 19, Ontario; 5430 Ferrier Street, Montreal 9, Quebec. A subsidiary of Daystrom, Incorporated.

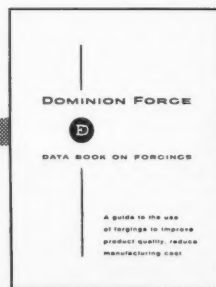
## DAYSTROM-WESTON

*Industrial Instruments*



# 

The duplicated facilities at Dominion Forge are another reason for the big extras in forgings Dominion delivers at no extra cost to you



Multiple equipment is the forging user's best guarantee of "on time" delivery and quality forgings at a consistent price. You can count on all three when your supplier is Dominion Forge, one of North America's great forges.

Dominion's forging and auxiliary equipment is not matched for versatility by any other commercial forge on the continent. Any down-time for repairs and maintenance with which Dominion Forge has to contend never slows Dominion's production, hence never interferes with yours. It's another reason for the big extras in forgings Dominion Forge delivers *at no extra cost to you!*

Whatever you require in forgings—from 15 to 150,000 of one design, in sizes from an ounce to over 300 pounds—your Dominion Forge *forging engineer* is trained to help you get *all* the extras in forgings. You're invited to call on his experience.

## DOMINION FORGE LIMITED



MEMBER: DROP FORGING ASSOCIATION

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**BOARD HAMMER OPERATOR** Danny Romano and over 125 other members of Dominion's Quarter Century Club are representative of the forging experience available to you.

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# THIS IS GLASS

A BULLETIN OF PRACTICAL NEW IDEAS



FROM CORNING

## POPPER THAT'S A STOPPER

It has been pointed out to us that every day the world survives, fewer are the chances that anything is the most, the biggest, the only, or the first.

But this corn popper is a first—to the best of our knowledge.



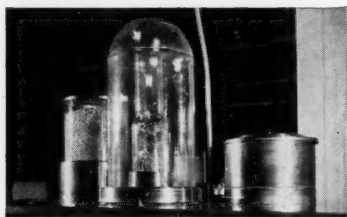
This machine pops corn with hot air—and all the action takes place before your eyes.

But that's putting the cart before the horse, because it was quite a number of moons ago when the designers at Electric Cooker Division of General Foods were at the idea-developing stage.

They wanted a new way of popping corn. And they wanted to boost sales by having all the popping parts visible.

So, they developed a way of turning kernels into a fluffy delight with a blast of hot (about 200° F.) air. Then they turned to Corning.

And Corning in turn came up with a number of key components made from a PYREX brand glass. Included are a 17-inch display dome, 13-inch lamp chimney, and an 8-inch chamber for storing unpopped corn.



Why a PYREX brand glass? Because you can use it at elevated temperatures without worrying about thermal shock. (For example, PYREX brand glass No. 7740 has a linear coefficient of expansion of  $32.5 \times 10^{-7}$  in./in. between 0° and 300° C.)

Also, you can see through glass (an obvious but still extremely useful feature).

And glass is so easy to keep clean, there's no place for dirt to lodge in its smooth surface. Glass No. 7740 also is resistant to the attacks of most acids and alkalis and stands up well under distilled water.

You can find machines dispensing corn popped by hot air at Woolworth's, Grant's, Kresge's, McCrory's, Newberry's and Sears Roebuck & Company. You

can find glass answers to one of your materials or component problems by coming to Corning.

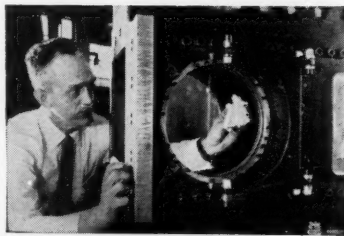
You can get a head start by perusing "This Is Glass," a 64-page, well-illustrated primer. And/or ask for Bulletin B-83, a detailing of mechanical, thermal, electrical, and chemical properties for three of Corning's most popular types of glass. Use the coupon.

## PURITY—KEY TO FUSED SILICA'S VERSATILITY

What material would you pick if you had the problem of accurate spectrum transmission, growing high-purity crystals, or building a component that would not darken under radiation?

The answer: Corning's 100% Fused Silica, an extremely versatile material that will handle these, as well as many other, specialized tasks. And the key to this material's versatility is its extreme purity.

Capacity to stand up to high temperatures, coupled with optical properties that yield excellent schlieren or shadow-graph quality, makes fused silica a natural for installation in wind tunnels for designing supersonic aircraft and missiles.



Optical purity and a high softening point (1585° C.) make Corning's 100% Fused Silica useful in wind tunnel windows.

Fused Silica also is used in ultrasonic delay lines, being well suited for handling delays ranging from 10 to 16,000 microseconds. More: You'll find this material possessed of high electrical breakdown resistance, low dielectric loss, and low expansion. And it is permeable to helium.

Uses (other than ultrasonic delay lines and windows for wind tunnels) include

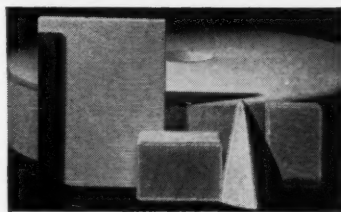
the following: windows for high-temperature applications, windows for hot cells, and the optical components for ultra-violet instruments.

All the facts are now available in spec sheet form. Check the coupon.

## NEW—CELLULAR CERAMICS

Now, for the first time, from Corning's Cercor process, you can get thin-walled cellular ceramics.

These cellular ceramics are lightweight, resist oxidation, and have an extremely high surface area. Here is a sampling of Cercor products.



The material used to make these objects has 1500 square feet of surface area per cubic foot. Individual wall thickness averages only 0.005 inch; weight is only 30 pounds per cubic foot.

This material can withstand temperatures up to 1800° F. with virtually no thermal expansion, and can be operated continuously at 1290° F. At either temperature you don't have to worry about thermal shock or oxidation.

To provide additional strength, a ceramic coating can be bonded to the exterior of most cellular forms.

The composition of the Cercor materials may be changed to provide desired physical and chemical properties, and further development is expected to result in a broadening of potential configurations and product shapes.

Suggested uses so far include structures for use in gaseous heat exchangers, catalyst supports, burner plates, column packing, and acoustical filtering, flow control, insulation, and structural materials in high-temperature applications.

Inquiries invited. And/or ask for a just published bulletin detailing all pertinent data and characteristics.



CORNING MEANS RESEARCH IN GLASS

## CORNING GLASS WORKS

39 Crystal Street, Corning, N.Y.

Please send me: ☐ "This Is Glass"; ☐ Bulletin B-83; ☐ Fused Silica; ☐ CERCOR

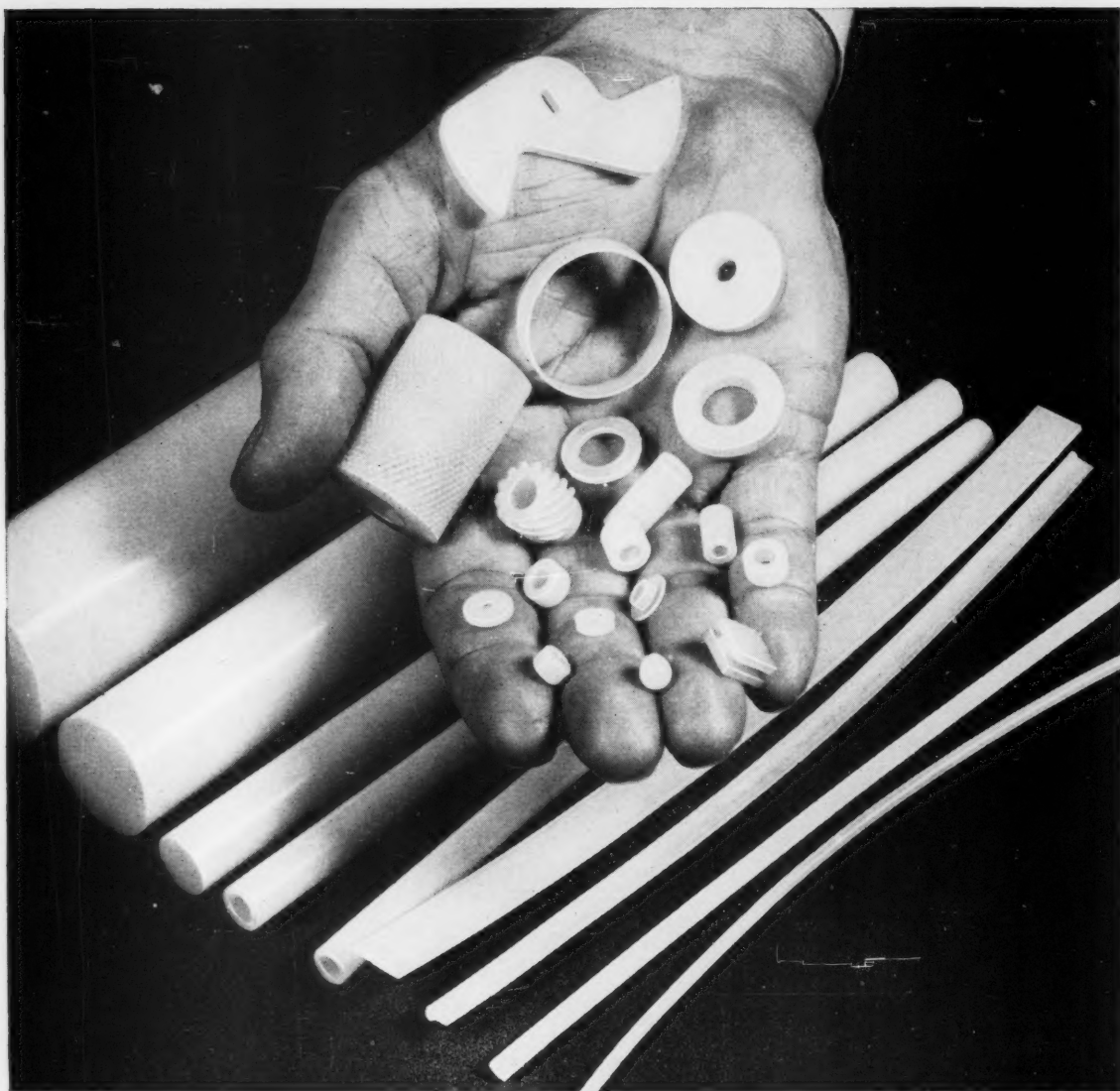
Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

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MEET A SOURCE OF NYLON . . .

### so versatile it can furnish basics or fabricated parts

Looking for a dependable source of Nylon strip, rod or tubing? Or fabricated parts to cut your costs? You'll find what you need at National. We stock *extruded rod* for immediate shipment—sizes from  $\frac{1}{16}$ " to 2" diameter. You can order *tubing* for both high and low pressure applications—

sizes  $\frac{1}{8}$ " to  $\frac{3}{8}$ " O.D. and .078" to .295" I.D. *Strip* is supplied in sizes .010" to  $\frac{1}{8}$ " thick and up to 6" wide. *Fabricated parts* can be specified in almost limitless variety—and we'll deliver these 100% usable parts to coincide with your production needs. National has the years of plastic

fabricating experience, the men, machines and capacity to meet all your requirements—from one dependable source.

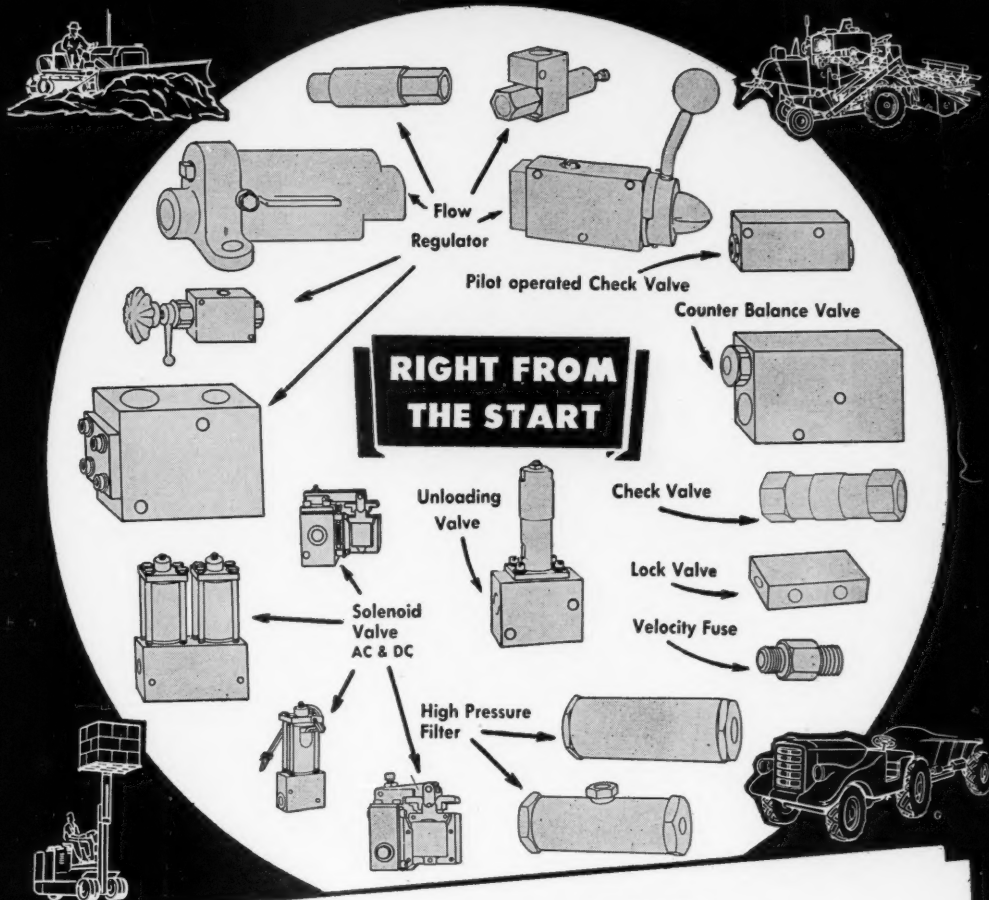
For grades and properties, write Dept. NN-1 for our Technical Data folder or contact your National Sales Representative.



**NATIONAL FIBRE COMPANY OF CANADA, LTD.**

ATLANTIC & HANNA AVENUES, TORONTO • 1411 CRESCENT STREET, MONTREAL

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**All of the above valves have been used in various types of applications, including Material Handling, Road Building, Machine Tools, Farm Equipment and Earthmoving.**

**We invite you to send us your applications and take advantage of our experience to help analyze your problems.**

**Bulletins on any of these products sent on request**

**Also suppliers of AN and MS qualified Flow Rate and Volume Controls to the Aircraft Industry.**

**WATERMAN**  
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what's special  
about a  
Canada Iron

**DOMITE** \*

casting?

What will it do for you? Will it save money? Will it reliably meet specifications? Will it possess longer life? The answer is "yes" to all three. Because Domite is superior cast iron. Domite is laboratory controlled to meet the need with the properties you require.

Canada Iron is Canada's oldest foundry organization. They have the experience, the laboratories and the metallurgists. Get the most for your casting dollar... Call Canada Iron, their representative will give you full details.



**Canada Iron  
CASTINGS**

CANADA IRON FOUNDRIES, LIMITED

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Canada Iron manufactures all grades and types of cast iron, for convenience classified as follows and complying fully with A.S.T.M. A48 where applicable. Here are some typical examples:

**DOMITE "30":**

Better than average cast iron.  
Minimum tensile strength 30,000 psi.  
Typical Brinell hardness 200.

**DOMITE "40":**

High strength, medium cross-section.  
Minimum tensile strength 40,000 psi.  
Typical Brinell hardness 235.

**DOMITE "50":**

High strength, heavy cross-section.  
Minimum tensile strength 50,000 psi.  
Typical Brinell hardness 260.

**DOMITE WEAR RESISTING:**

Type WR—A, B, C and D  
(type depending on service involved).

**DOMITE HEAT RESISTING:**

Type HR—A, B, C and S  
(type depending on service involved).

**NI-HARD:**

Alloyed white iron, Brinell 550-650.

**NI-RESIST:**

High nickel alloy cast irons for corrosion and heat resistance. Tensile strength 25,000 to 30,000 psi, Brinell 130-180.

**DUCTILE NI-RESIST:**

Composition and properties as for Ni-Resist, but with 60,000 psi tensile strength and 10% elongation, strong and shock resistant.

**NODULOY, DUCTILE IRON:**

Nodular or ductile cast iron in a complete range of properties, from 60,000 psi tensile and 20% elongation at 160 Brinell to 180,000 psi tensile at 330 Brinell. Available also in special heat resistant grades.

MEMBER



\*Trade mark registered

Circle number 152 on time saver card





# RADICON

the **original** fan cooled  
**WORM REDUCER**

Saves money 2 ways

- 1. LOWER INITIAL COST**
- 2. MORE HORSEPOWER PER POUND**

There's a Radicon made for every speed reduction job. Write us for complete details and illustrated literature.

*No waiting—we can deliver immediately from our large and complete stock.*



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172 Clement St., Ville LaSalle  
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DBR-56-1

*Tubexperience in action*



A GOOD REASON FOR PREFERRING SUPERIOR

## *When tubing must be perfect for just split seconds*

**Superior Super Alloy tubing passes this high temperature and corrosion test!**

When rocket engines ignite, tubing must perform while undergoing high heat and corrosive action and unusual stresses. The life of any tubing is necessarily short. But to meet these severe operating conditions, it must be as nearly perfect as human skills can make it.

**\*Superior Super Alloy tubing** is ideally suited for such applications. We produce small diameter Super Alloy tubing in 16 materials. They offer high temperature, creep and fatigue strength and high resistance to corrosion and oxidation.

*Special Services and Tests*—Because tubing specifications for

guided missiles, rockets and jets are exacting, special tests and inspections may also be required. We are well equipped for this. We perform dye penetrant inspection, ultrasonic and hot tensile testing, eddy current and X-ray inspection, and many quality-control checks to special order.

We will also develop new Super Alloys for customers, from melting stage to pilot run of the tubing.

For technical data on Superior Super Alloy tubing, write for a free copy of Bulletin 70. Superior Tube Company, 2052 Germantown Ave., Norristown, Pa.

# *Superior Tube*

The big name in small tubing

**NORRISTOWN, PA.**

*All analyses .010 in. to 3/4 in. OD—certain analyses in light walls up to 2 1/2 in. OD*

West Coast: Pacific Tube Company • 5710 Smithway St., Los Angeles 22, Calif. • RAYmond 3-1331

Circle number 140 on time saver card

**How do you judge hydraulic and air equipment?**

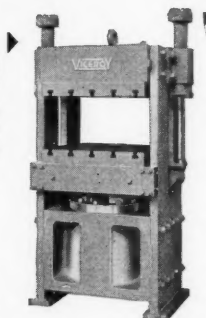
**VICEROY superior quality and design  
meets the ultimate in manufacturers needs**

**for the finest  
of its kind specify —**

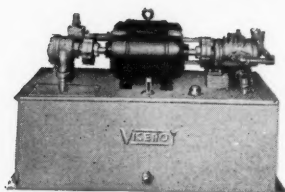
**VICEROY**

**ENGINEERING DIVISION**

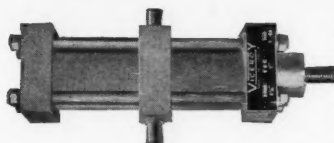
Compression moulding presses, steel slab side or strain rod construction, heated or unheated, 35 to 400 ton capacity.



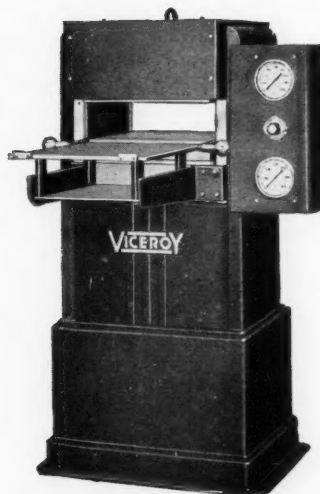
Oilhydraulic pumping units to any requirements from .5 US/GPM to 120 US/GPM, and pressures to 3000 psi.



Viceroy air hoists permit effortless lifting of loads up to 4000 lbs. Ruggedly built for years of trouble free service.

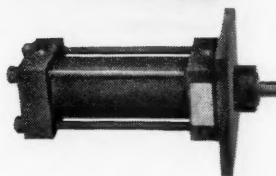


Trunnion-mounted air or hydraulic cylinders provide versatility and variance from straight line operations.



Vulcanizer presses and allied equipment for the printing trade, steam or electrically heated, provide extreme accuracy for all uses.

Front or rear flange-mounted air cylinders for use at 150 psi. Also oil or water to 500 psi, and hydraulic series to 2000 psi.



Illustrated is a clevis-mounted type cylinder, but any one of 7 mounting types can be supplied as standard. All end caps of steel bar stock or fabricated construction, depending on size.

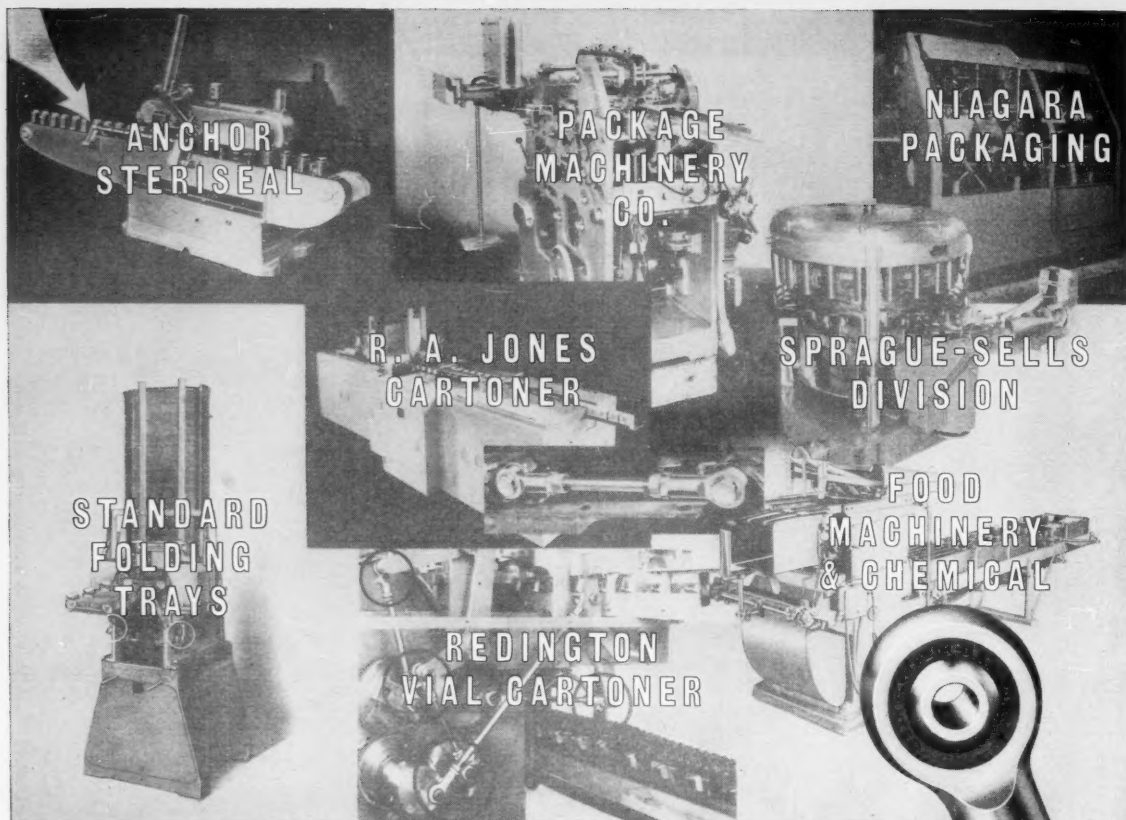


Literature and additional data available on request — your enquiries are invited.

**VICEROY MANUFACTURING CO. LTD.**

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Manufacturers of Packaging Machinery specify . . .

## HEIM Unibal SPHERICAL BEARINGS AND ROD ENDS

Cartoning machines fold package inserts and assemble them with the bottle or vial, insert them in a carton and deliver the finished package ready for shipment.

Rotary Fillers draw liquid or semi-liquid materials into a cylinder and discharge them, in accurately measured amounts, into containers.

Casers assemble a load of cans, and insert the load into a case — at unusually high speeds.

The Steriseal machine is used for high production steam vacuum sealing of glass containers.

Bottles, jars, tubes, and a variety of articles are fed from the labeling machine to the cartoner which opens the folding box, inserts the contents, then tucks and delivers the complete package.

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Imprinting of the package is done in one pass through some machines.

The motions involved in the push-pull linkages of this automated machinery are intricate and ingenious. Heim Unibal Spherical Bearing Rod Ends are used where it is necessary to correct inherent misalignments, and where close accuracy of fill and smooth operation at each station are mandatory.

They are used as suspended bearing supports for belt rollers. They change motion from vertical to horizontal plane, and vice versa.

The Unibal Spherical Bearing is exactly right as the support on one end of a helicoid timer, where a rotating shaft moving in all directions requires a focal point or fulcrum.



Quick and simple push-pull linkage assemblies are possible with one female threaded and one male threaded Unibal rod end. There is practically no limit to the length of linkages possible.



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WHICH GIVES COMPLETE DATA,  
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DETAILS OF YOUR APPLICATIONS.

## R&M BEARINGS CANADA LTD.

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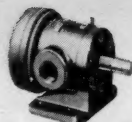
FACTORY REPRESENTATIVES AND DISTRIBUTORS FOR CANADA



# VICKERS® ...the MOST EXTENSIVE LINE of hydraulic units and complete systems available in CANADA

Shown here are only a few representative Vickers hydraulic units that are available in Canada. Having the most complete line of hydraulic equipment, Vickers-Sperry offers you the advantages of undivided responsibility and the assurance that all components can be combined for optimum performance. For further information, ask for Bulletin 5001B.

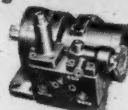
## PUMPS



Vane Pump



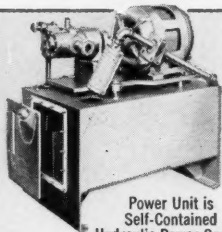
Two Stage Vane Pump (2000 psi)



Double and Two-Pressure Vane Pumps



Variable Delivery Piston Type Pump



Power Unit is Self-Contained Hydraulic Power Source

## PRESSURE CONTROLS



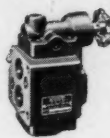
Balanced Piston Type Relief Valve



Hydrocushion Type Sequence Valve



Hydrocushion Type Counterbalance Valve



Pressure Reducing Valve



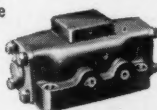
Flow Control Valve with Hydrostatic Compensator

## DIRECTIONAL CONTROLS

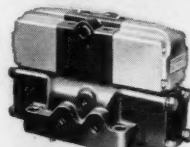


Rotary Type Four-Way Valve

Plunger Type Four-Way Valve



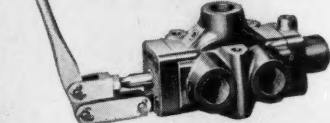
Pilot Operated Four-Way Valve



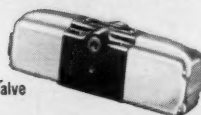
Solenoid Controlled Pilot Operated Four-Way Valve



Check Valve



Manually Operated Four-Way Valve



Solenoid Operated Four-Way Valve

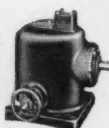


Deceleration Valve

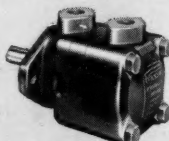
## MOTORS



Constant Displacement Piston Type Motor



Variable Displacement Piston Type Motor



Balanced Vane Type Motor

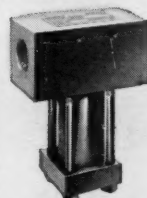


Hydraulic Cylinders

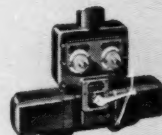
## ACCESSORIES



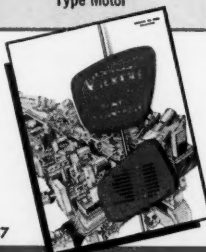
Accumulators



High Pressure Type Micronic Oil Filters



Traverse and Feed Cycle Control Panel



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Bulletin No. 5001B is a catalog for quick, easy reference. It gives you the essential information on a wide range of Vickers Oil Hydraulic Pumps and Controls. A copy will be sent immediately on receipt of your request.

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NOW AVAILABLE IN CANADA...KL... A VERSATILE, RELIABLE, LOW COST P & B RELAY

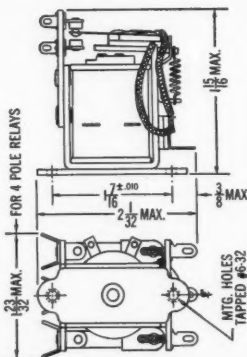
## for communications and automation

**ECONOMY** and versatility distinguish our KL series relays. Contact arrangements are available up to 4 pdt in either AC or DC versions. Sensitivity of 100 milliwatts per movable arm is available.

Stationary contacts and terminals are mounted on a phenolic front of high dielectric strength, thus adding to the utility of the relay. Conveniently located terminals and easy-to-mount base greatly simplify installation on long production runs.

KL relays may be hermetically sealed or furnished in metal dust covers.

This is one of a "family" of fine P&B relays. Others, with similar configurations but various electrical and switching capacities, are shown below. Write or call for more information or see the complete P&B catalog in Sweet's Product Design File.



### KL ENGINEERING DATA

**GENERAL:** Breakdown Voltage: 500 volt rms, 60 cycle between all elements standard 4 pole relay; 1500 volts rms, 60 cycle on special 3 pdt relay.

**Temperature Range:** -45°C. to +85°C.

**Pull-In:** Approx. 75% of nominal dc voltage.

Approx. 78% of nominal ac voltage.

**Terminals:** Pierced solder lugs for two #20 AWG wires.

**Enclosures:** Metal can 2 1/4" high x 2 1/4" long x 2 1/4" wide with octal plug or multiple solder header.

**CONTACTS:** Arrangements: up to 4 pdt.

**Material:** 1/8" dia. gold-flashed silver. (Others available.)

**Load:** 5 amps @ 115 volts, 60 cycle resistive loads.

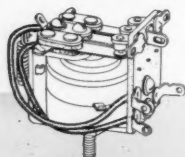
**COILS:** Resistance: 60,500 ohms max.

**Power:** 100 milliwatts per movable arm.

**Duty:** Continuous; coils will withstand 6 watts @ 25°C.

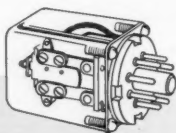
**Voltages:** up to 110 volts dc.  
up to 230 volts ac.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



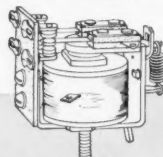
#### KR SERIES: SMALL, 5 AMP RELAY

Ruggedly constructed for long life and dependability. Available up to 3 pdt.



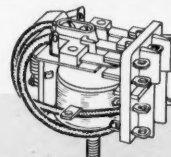
#### KCP SERIES: SENSITIVE 3 PDT RELAY

For plate circuit applications requiring low cost, sensitive relay. Polyethylene dust cover.



#### KT SERIES: ANTENNA RELAY

Insulated to minimize RF losses. Designed to switch 500 watts RF input to 300 ohm line.



#### KA SERIES: GENERAL PURPOSE

Compact, light-duty relay. U/L approved. Meets 1500 volts rms breakdown requirement.



# POTTER & BRUMFIELD

CANADA LTD.

GUELPH, ONTARIO

## A different channel valve

**Trapped gas cushions valve on opening and prevents its impact against stop plate**

The channel valve (developed and patented by Ingersoll-Rand) is entirely different from any other compressor valve now in use.

Each valve consists of a valve seat (A), several channel-shaped valves (C) (which fit over and close a corresponding number of ports in the seat), a bowed-leaf spring (D) for each channel and a stop plate (E), which limits the lift of the valve.

The valve guides (B) are made of a special graphitic carbon (chosen for its self-lubrication properties) whilst the channels are fitted with special wear trips (of Teflon) to eliminate friction.

The normal function of the spring is to return the valve to its seat after the air has passed through. In the channel valve, however, each spring has an additional function. It fits within its channel and, as the valve opens, a pocket of gas is trapped between the bowed spring and the channel. This cushions the opening of the valve and prevents impact of the valve against the stop plate.

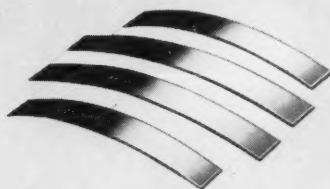
Since the cushioning pocket is not closed until after the valve is in motion, the cushioning action is delayed, or controlled, so that only a small differential pressure is required to open the valve. Thus it lifts quickly, without impact, to its full opening along the entire length.

The channel and spring feature makes the valve highly efficient, durable and quiet.

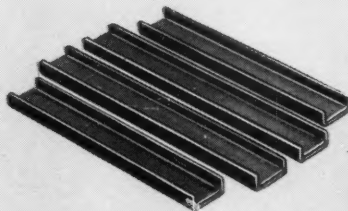
High pressure channel valves are available for pressures up to the range of 300 and 500 psi.



(E) Stop Plate



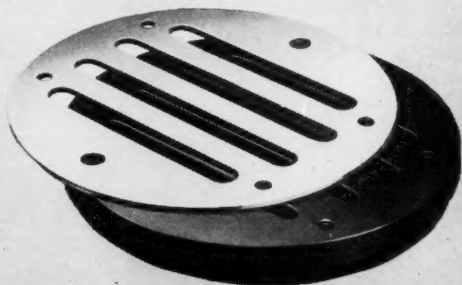
(D) Springs



(C) Valve channels



(B) Valve guides



(A) Valve seat

*The valve stripped down to its essential parts*

## Open Centres

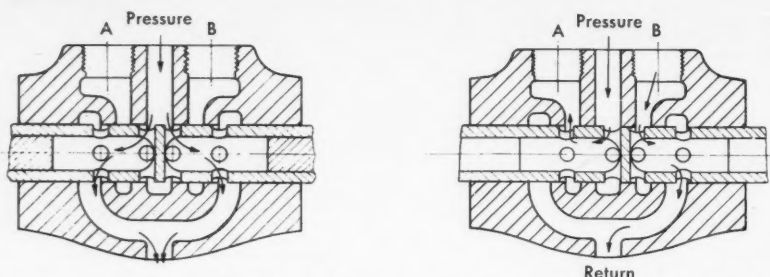


Fig. 1.

When using this type of system, the hydraulic fluid will freely circulate when the piston is in the neutral position. This type has the ports arranged so that when banked, the valves are in series relative to the fluid flow, i.e., the return flow from the double-acting ram, and fluid is then passed into the pressure port of the immediately adjacent control valve.

## Closed Centres

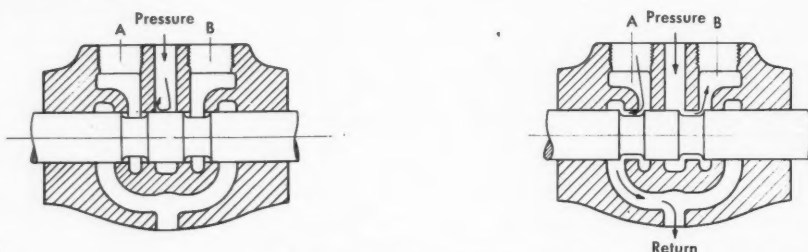


Fig. 2.

In this arrangement, when the piston is in the neutral position it forms a shut-off valve on the pressure side, and a relief/unloader valve is employed. When valves are banked they are in parallel relative to the fluid flow, i.e., common galleries connect both pressure and return ports.

# Control valves for many requirements

**Produced in three sizes these control valves can be used as single units or banked to form a multiple unit — just by using minimum, basic parts**

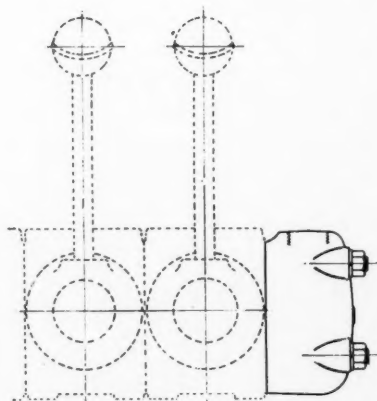
To meet the varied requirements of industry, Dowty control valves are available at low cost in many forms to suit specific applications. They may be employed as single units, or banked to form a compact multiple unit of any number of valves, using the minimum number of basic parts.

A relief unloader valve is available for the assembly, thus obviating the need for a separate relief valve or a variable delivery pump.

Under special conditions, where perfect sealing is demanded (for example, to hold a loaded ram for a long period) a locking device can also be added to the control valve.

The two basic types provide either open or closed centres (see Figs. 1 & 2), and provision is made for either spring centre or ball detent control lever actuation. The position of the control lever can be rotated through 90 deg to provide 4 positions.

These control valves are produced in three sizes, the largest of which is capable of handling up to 50 gpm depending on the exact type of pressure conditions. ★







*Pump components. High nickel alloys and high speed tool steels will withstand the heat of operating temperatures.*

## Piston pumps designed for missile use

**This new pump design was dictated by high temperature applications.**

Constant pressure, variable displacement, piston-type hydraulic pumps (specifically developed for high-temperature applications in aircraft and missile hydraulic flight control systems) are available from Pesco Products Division, Borg-Warner Corporation.

The new pump design features increased reliability at higher operating speeds, insensitivity to the type of fluid used, high-temperature bearings, all-metallic O-rings and seals, and a minimum of rotating parts.

Available with either single or dual pumping elements, the pumps are designed to run at speeds up to 7,500 rpm. The pumps are recommended for use with fluid temperatures up to 550 F and ambient temperatures up to 600 F, and cover a range of capacities from 3 to 27 gpm, when operating at rated speed. System pressures for these capacities are generally 3,000 psi, although some pumps (such as the dual unit type) are used in 4,000 psi systems.

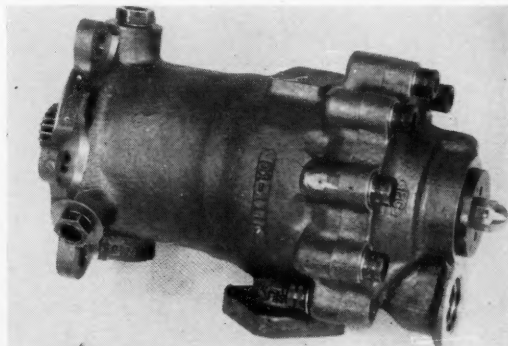
Research with various materials at the Pesco laboratories resulted in the use of metallic seals and O-rings in these pumps. Metallic seals (unlike the elastomeric type) are unaffected by temperature or the type of fluid used in the system. In pumps equipped with metallic seals, OS-45, F-50 versilube and MLO-8200 fluids have been used interchangeably with equal effectiveness. No deterioration of seals resulted.

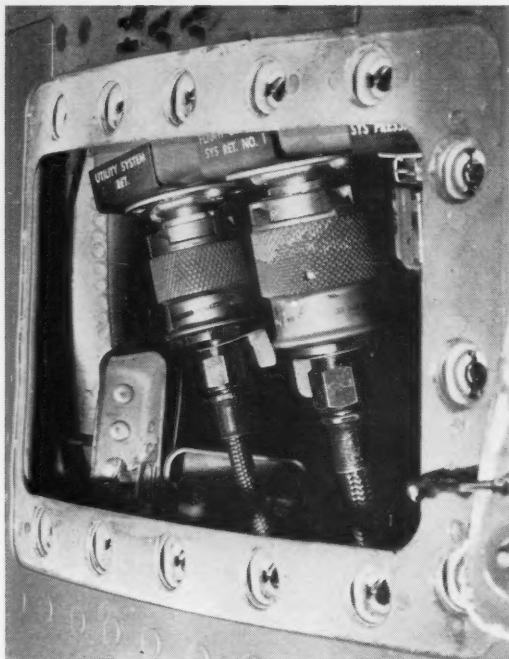
A metal bellows type rotating seal is incorporated

in the pumps for it has proved the most effective for operation in systems where shock and vibration (such as that experienced in missiles and chemical engine operation) is encountered. The bellows design of the metallic seal permits greater flexibility in the pump, effectively absorbs shock loads, and thus results in longer operating life.

The body and cover of the pumps are made of nodular iron or stainless steel to suit specific operations. ★

*Pump assembled, 5,000 rpm gives output of 3,500 psi.*





*Hydraulic system of F-100 uses coupling extensively.*

## Quick disconnect coupling automatically self-seals

**Two spring and four "ears" help to make this coupling a standout**

**Donald F. Collins** PARKER AIRCRAFT CO.

Self-sealing, quick-disconnect couplings are hydraulic components used where frequent removal of equipment calls for the disconnection of hydraulic lines, without loss of fluid or drainage of the system.

Couplings of this type are self-sealing in the sense that both ends of the device are automatically sealed off when the coupling is parted. Each half of the coupling has a poppet that makes it (in effect) a poppet valve. When the coupling is separated, the springs loading the poppets force them against their seats and prevent fluid from flowing through the coupling while it is disconnected.

Another distinctive feature is that, while most other types of hydraulic coupling are screwed into place on conventional AN threads, a quick-disconnect coupling uses dogs that clamp onto a flange, or a short helical thread, or some other type of fastening device that permits rapid disconnection.

Poppets (and the springs that keep them in place) must be so designed that they cannot become misaligned during service. Otherwise, when an accumulator is suddenly released (in a high performance aircraft, for example) the sudden surge of hydraulic fluid rushing through the system will cock the poppets (or the springs), preventing proper sealing when the line is disconnected. Furthermore, the poppets must be designed so that a flow reversal will not close the poppets and block off the line.

A good coupling should be capable of rapid connection (and disconnection) by hand, without any special tools. (In an emergency, this would not be possible if special tools were required). Furthermore, it should be

possible to connect and disconnect the coupling under pressure. Frequently, when a line is blocked, the line pressure is retained, so that a disconnection must be made under pressure.

Faced with these requirements, the engineers of Parker Aircraft Co., have developed a series of self-sealing, quick-disconnect couplings with all the desirable features of a good coupling, based on an original design of the Bohannon Co.

### Design details

These couplings were designed to meet the requirements of a Class II hydraulic system, (temperature ranges from  $-65^{\circ}\text{F}$  to  $275^{\circ}\text{F}$ ). Capable of handling working pressures as high as 3,000 psig, the coupling has a flow capacity ranging from 1.2 to 45 gpm. Each flow size has been designed for a particular tube size. The  $\frac{1}{2}$  in. tube size, for example, is made to handle a flow of 6 gpm. However, it is possible to use any tube size with any flow size, because all the working parts of the coupling are contained in the basic coupling envelope; the workings do not extend into the nipples to which the tubing is connected. 1 in. tubing, for instance, can be connected to the  $\frac{1}{2}$  in. tube size coupling merely by modifying the porting.

Basically, the coupling is composed of two assemblies: a socket and a nipple (Fig 3). The socket assembly is designed for attaching to flexible hose or coiled tubing, while the nipple half is designed for installation on a bulkhead or any other fixed member. In order to keep the flexible hose from twisting during connection and disconnection of the coupling, the porting (on which the tubing is screwed) rotates within the outside lock.

## Quick disconnect coupling continued

Because the port is not directly attached to the lock, it is impossible to disconnect the coupling by pulling on the flexible hose connected to the port.

A special feature of Parker's coupling is the dual integrity feature brought about by the two springs used to load the lock. Other couplings have only one spring; if this fails, the coupling becomes disconnected. If one of the springs fails in the Parker coupling (shown in Fig 2), the other spring will carry the load and keep both halves firmly locked.

When the two assemblies are placed together before locking, the seat on the nipple assembly engages an O-ring in the socket assembly and makes a perfect hydraulic seal. Because sealing occurs before the poppets are cracked open, no fluid can possibly leak out. As the coupling is pushed further, the two poppets meet and are pushed off their seats.

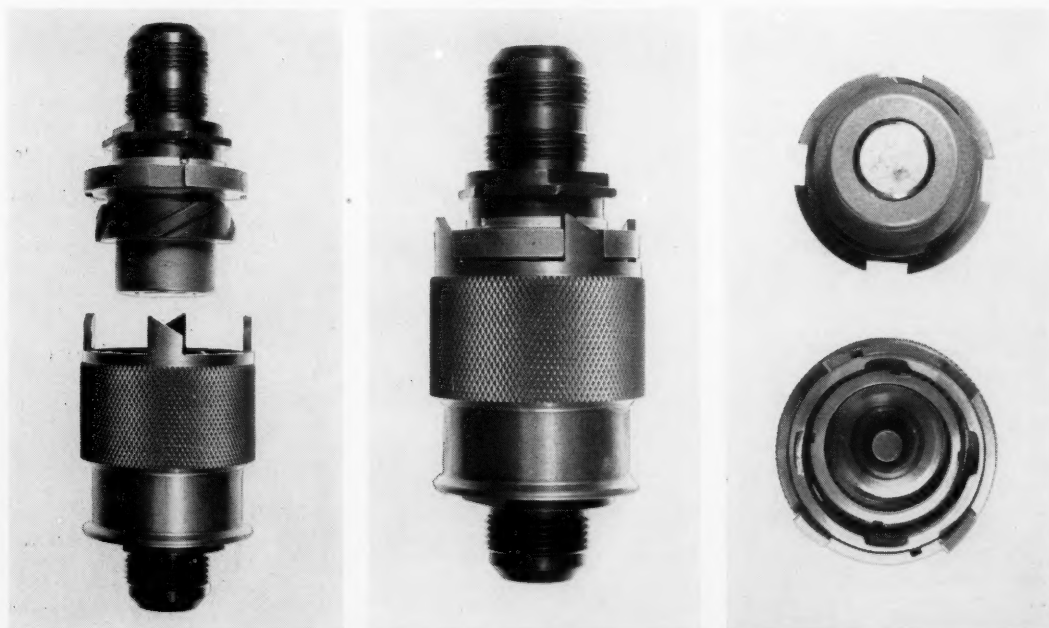
The length of the poppet controls the amount each poppet opens. In other words, the distance the poppet opens is independent of the springs. The only function of the springs is to close the poppets whenever the coupling is unlocked. The springs are identical on both sides, so that each poppet is opened the same amount. If for some reason one of the springs is stronger than the other, the one with the softer spring will bottom first. Both poppets will however, be wide open when the coupling is locked.

The locking action is achieved by four "ears" that project from the lock in the direction of the nipple assembly. These ears fit into four slots cut into the nipple assembly (Fig 3). When the sleeve is engaged as far forward as it will go, the ears have rotated because of the helical thread, so as to mate with these slots.

The coupling is now firmly locked. The force created by the two springs attached to the sleeve tries to untwist it (because of the threads) but since the ears mate with the slots, it is impossible for the sleeve to untwist and disconnect the coupling. To disconnect the coupling, in fact, the lock must be moved away from the nipple assembly. This disengages the ears and allows the socket assembly to untwist.

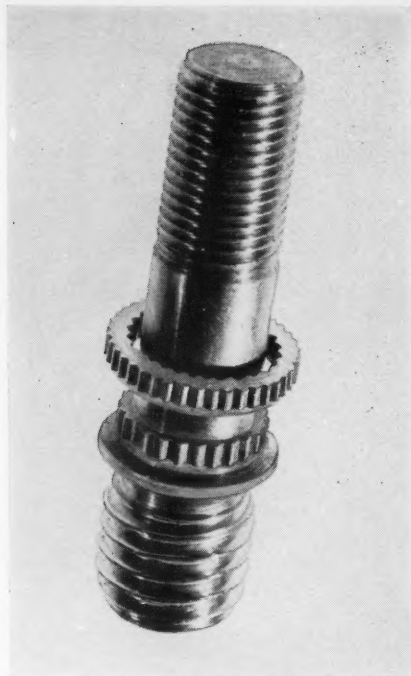
Perfect sealing (when the coupling is disconnected) is accomplished by a metal-to-metal contact. The principle of a spherical surface on the poppet resting up against a sharp corner has been used very successfully in check valves. The tolerances between the poppet diameter and the poppet guide diameter have been designed to allow the poppet to float and to find its own centre. As the poppets come to rest against the seats, a circle is formed on the spherical surface, making a perfect seal against the sharp corner of the seat. The spherical surface has almost a mirror, 8 RMS finish, to provide proper sealing.

The valves, their seats and the springs, all are of stainless steel. This makes it possible to use the device for very high temperature applications. Metallic seals and all stainless steel parts will be used in applications where the fluid temperature is 600 F or above. It is quite possible that these couplings could be used (with only minor design changes) in systems where the fluid temperature is as high as 1,000 F. There has not yet been a requirement for such a coupling, but there will be in the not-too-distant future. The major problem in such a system is how to obtain a satisfactory hydraulic fluid, but the temperature limits of aircraft hydraulic systems are steadily being pushed upward by the discovery of new high temperature fluids. ★



Socket and nipple-basic assembly. The Parker coupling assembled. Bird's eye view shows the "ears."





## Fluid studs and inserts effective team

**Complementing each other — this duo works under high pressure and doesn't need bosses or a thickened housing area to perform its best**

A series of fluid system studs and inserts can seal component and system parts against pressures up to 3000 psi. Designed by Rosan, Inc., for hydraulic, pneumatic and other pressurized fluid systems, these studs and inserts are used in installations where the fastener is exposed directly to pressurized areas or compartments.

The stud and insert has a collar placed at a specified distance above the top of the threads. Immediately below this collar is an annular recess where the packing ring is located. When the fastener is screwed into a threaded hole that is counterbored the packing ring is situated between the bottom of the collar and the bottom of the counterbore. Any leakage past the threads is then effectively stopped by the packing ring seal.

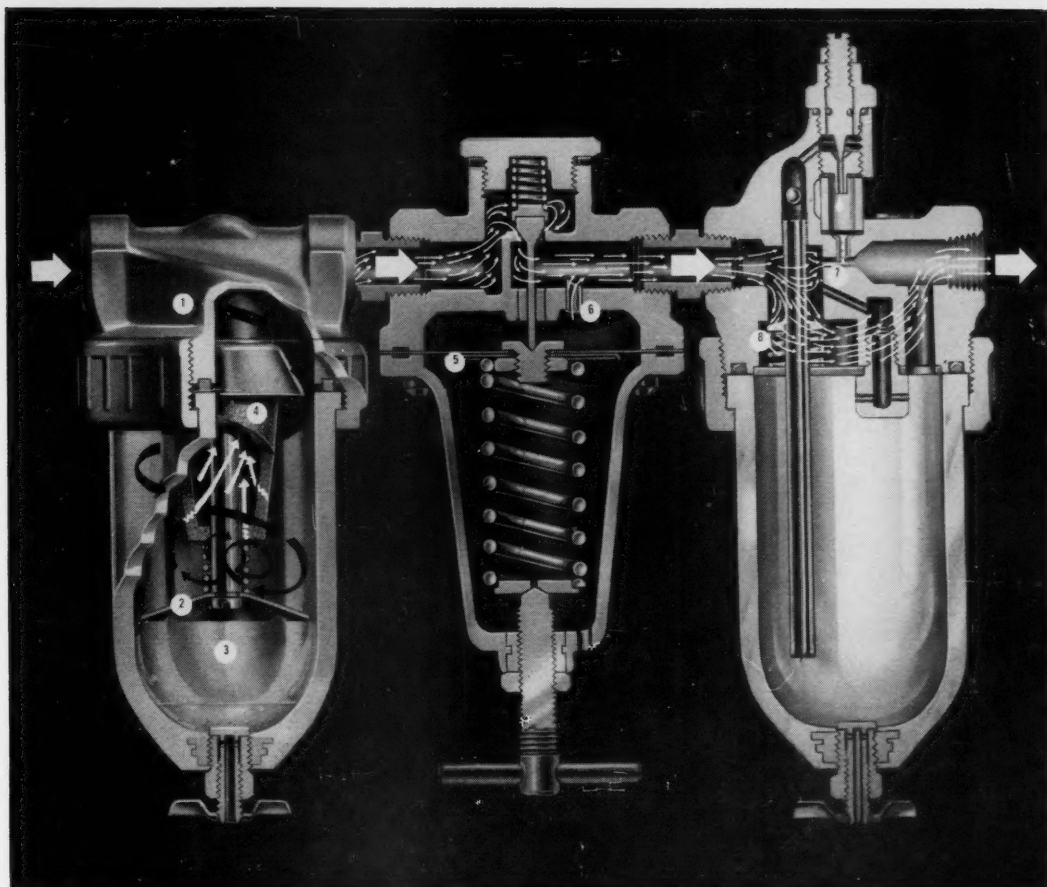
Because of the extreme vibrations that are experienced in so many fields of design, means of positively locking fasteners into place usually creates some difficulty. This technique of locking threaded fasteners has been adapted to the fluid studs and inserts to avoid any loosening that might cause leakage. The studs and inserts have a second collar, (above the first) that is radially serrated around the outer edge. When the fastener is screwed in place, a lock ring that is also radially serrated (around its inner and outer edge) is placed over the fastener. This is done so that the inner

serrations of the lock ring are aligned with the serrations of the fastener collar. When the lock ring is pressed into a counterbored section at the top of the hole, the aligned collar and lock ring serrations mesh like gears.

The counterbore at the top of the hole has a smaller diameter than the OD of the lock ring, so that when the lock ring is pressed into the counterbore, it actually broaches into the edge of the counterbore to prevent rotation of the insert or stud. This broaching action completes the positive locking of the fastener. Fluid system studs and inserts have been used in various types of industrial hydraulic and pneumatic equipment (such as pumps, turbines, valves and flow regulators) where it is convenient to have fasteners located with one end exposed to a pressurized region.

Where weight and size are important considerations in the design of pressurized fluid equipment, the fluid system studs and inserts provide an additional advantage. In many designs of fluid flow equipment that contain standard studs or inserts, it is necessary to add bosses (or thicken housing areas) to prevent the fastener from being exposed to the fluid under pressure. Weight is thus added. With the use of fluid system studs and inserts, it is not necessary to add this excess of material, since exposure of the fastener is no longer a problem. ★





*Cutaway drawing of the combination filter-regulator-lubricator shows details of the air flow through the unit.*

## Precise control with this air filter

**Delivering lots of clean, dry air at invariable pressure is this unit's job.**

**The most important steps of its efficient operation are traced below**

A continuous supply of clean, dry air, at a constant pressure and with just the right amount of lubrication provided at points of friction and wear is possible with the Watts combination of pneumatic controls.

The illustration shows diagrammatically an air line filter, a regulator and a Perma-Fog lubricator.

The curved inlet (1) directs incoming air in a downward helical pattern. Larger impurities and condensate are "thrown out" by centrifugal action and collect on the bowl sides and spiral downward past the baffle (2) into a quiet chamber for draining off. The baffle traps sediment in the quiet chamber (3) and allows only dry air (centrifugally cleaned of larger impurities) to reach the porous bronze filter element (4), where finer

particles are filtered out.

A diaphragm of large area (5) is made of Buna-N to impart extra sensitivity for response to even minute reduced pressure variations. The aspirator (6) acts directly on the diaphragm, providing instant compensation for fluctuating loads. This gives precise control, and stabilizes the pressures reaching individual pieces of equipment.

A high velocity venturi section (7) provides ultra-fine, enduring atomization even at air flow rates less than 1 cfm. An exclusive by-pass feature (8) provides lubrication at a high flow rate without excessive pressure drop. There is proof of lubricating efficiency because all visible metered oil is atomized. ★

In present-day manufacturing, material and equipment must move fast. Pneumatics (with its speed and resilience) can be the answer. The pneumatic circuit segments presented here may not be a definite solution to your particular problem in controlling rapid movement, but they do represent specific ways of slowing down a cylinder and should stimulate your thinking.

## Circuit segments; answer to air control?

**Though we now use the power of compressed air to push, pull, raise and lower — the future may hold other exciting, new roles for pneumatics. Meanwhile, here are some ways to stop that air cylinder smoothly**

**Herbert Gailey** ROSS OPERATING VALVE CO.

Speed and resilience are two of the many properties that make compressed air desirable as a source of power. This power can be used to push, pull, raise, lower or rotate. The speed of air power can be used to move an object rapidly, and the resilient property used to bring the rapidly moving object to a gentle stop.

The most common method of obtaining straight-line motion is by a cylinder actuated and controlled by a valve. The rapid movement of the piston in a **non-cushioned** cylinder can create a considerable amount of self-destructive energy, destroying not only itself but also other interrelated equipment. On the other hand, the **cushioned** cylinder uses the resilient quality of air to retard the last 1/2 or 3/4 in. of stroke, to reduce the piston impact.

### The Speed Control Valve

The simplest and most common method of controlling the speed (or rate of cylinder travel) is the speed control valve. This valve contains a check and variable restriction, permitting unrestricted pressure to enter the cylinder, and the exhaust air to pass through the variable restriction. Through its use, the cylinder speed is controllable throughout the cylinder stroke. Circuit segment (A) will illustrate.

Through the use of just one speed control [as in (A)]

only the extending of the cylinder rod is under control, while the retraction is rapid. Adding a speed-control valve to the blank end of the cylinder will provide the variable restriction for exhaust air, and a controlled speed of retraction is obtained. With this addition, the cylinder speed of extension and retraction can be independently controlled.

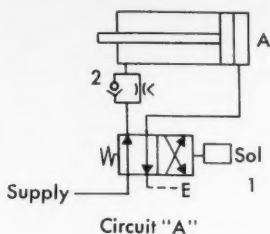
In designing an acceleration and deceleration circuit many conditions must be taken into consideration, such as the weight of the moving mass, distance and velocity, friction air pressure and so on.

Deceleration in circuit segments (B) and (C) is obtained by diverting the exhausting air through the variable restriction in the speed-control valve (3). For maximum speed, both ends of the cylinder should be exhausted, so that when air pressure is introduced at one end of the cylinder, there is only atmospheric pressure to overcome at the other end.

The circuit segments (D) and (E) use the principle of diverting the free flow of atmospheric air to controlled flow to obtain deceleration. Circuit F is controlled electrically and has a common deceleration control.

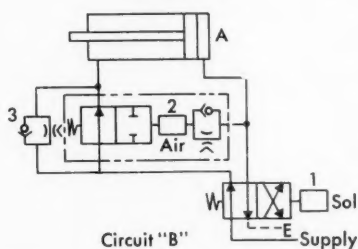
All the above methods of deceleration consume time, because the atmospheric air must be diverted some time before the cylinder comes to a stop, due to the slow controlled build-up of back pressure created. Some circuit segments introduce compressed air to slow the rapid stroking cylinder. This can be a time-saver, for the cylinder travels at high speed for most of its strokes.

### CIRCUIT (A)



Actuating Valve (1) pressurizes blank end of cylinder (A). Pressure in rod-end must exhaust through variable restriction in speed-control valve (2).

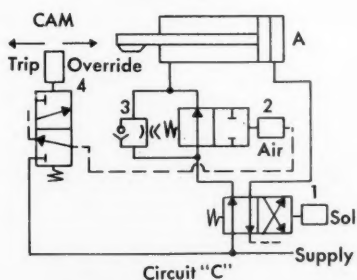
### CIRCUIT (B)



This circuit segment shows a deceleration of cylinder stroke by time. Actuating valve (1) pressurizes blank end of cylinder (A), extending rod rapidly. In the meantime, sequence head of valve (2) is "metering in" pressure to close normally open valve (2). When (2) closes, balance of exhaust air from rod-end of cylinder must pass through speed control valve (3). Rod slows up to desired rate of travel.

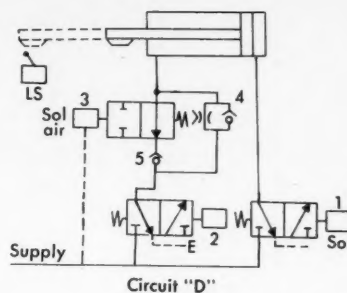
Due to air pressure and friction fluctuations, the starting point of deceleration of cylinder rod may vary a slight amount.

### CIRCUIT (C)



Shows a deceleration of the cylinder stroke controlled by position. Cylinder rod will start to decelerate at the same point in its stroke each time. Actuating valve (1) pressurizes blank end of cylinder (A), extending rod rapidly until projection on rod contacts cam valve (4). When (4) is opened, it pressurizes air-operated head of normally open valve (2), which closes. Balance of exhaust air from rod-end of cylinder must pass through speed control valve (3). Projection on cylinder rod drops off cam follower of valve (4) at the end of cylinder stroke and overrides on rod retraction.

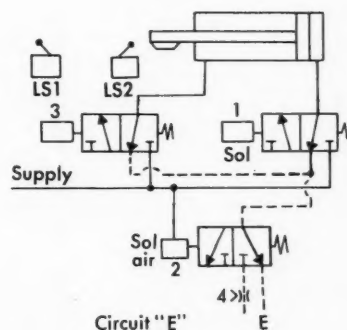
### CIRCUIT (D)



Actuating valve (1) pressurizes blank end of cylinder (A), extending rod rapidly until overriding limit switch (L.S.) is closed. Limit switch actuates solenoid pilot of straight way normally open valve (3). Valve (3) closes, blocking exhausting atmospheric air in rod-end of cylinder. Balance of air in rod-end of cylinder is then passed through variable restriction in speed control valve (4). Restricted air builds resistance, slowing cylinder extension. At the end of stroke, L.S. is opened, permitting valve (3) to return to normal. Activating valve (2) retracts cylinder.

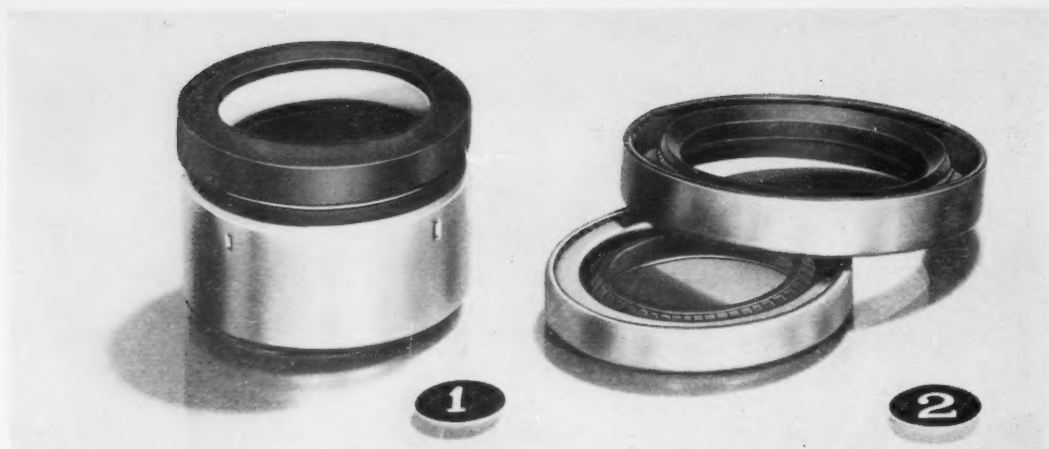
Check valve (5) is provided to prevent pressure flowing through valve (3) in reverse and creating an air-locked condition.

### CIRCUIT (E)



Energizing solenoid of valve (1) passes air to blank end of cylinder (A), extending it rapidly. Atmospheric air in rod-end of cylinder passes through (E) port of valve (2). Overriding limit switch L.S.1 is closed by cam on cylinder rod. L.S.1 energizes solenoid of selector valve (2). Valve (2) is actuated and balance of atmospheric air in rod-end of cylinder passes through variable restriction valve (4). Restriction creates back-pressure, which decelerates cylinder speed. At the end of stroke, cam permits L.S.1 to open, which in turn lets valve (2) return to normal.

Energizing solenoid of valve (3) will retract cylinder rapidly, until overriding limit switch L.S.2 is closed. L.S.2 energizes solenoid of selector valve (2) which is actuated, atmospheric air in blank end of cylinder passes through valve (4), cylinder retraction decelerates. At the end of stroke, cam permits L.S.2 to open and de-energize solenoid of (2), which returns to normal.



1. Mechanical Mechanipak seal utilizing a Viton bellows. 2. Klocure oil seals with Viton sealing element is shown.

## Versatile material for gaskets, seals

Viton is a versatile, broad-temperature-range polymer developed by Du Pont. It has been so successful in military aircraft and missile applications that it is now being used by The Garlock Packing Company for vital packings, seals and gaskets.

Basic formulations of the material have been developed with durometer hardness values ranging from 60 to 90. These formulations will be used in manufacturing O rings, Chevron packings, Klocure oil seal elements, Mechanipak mechanical seal bellows, sheets and molded and extruded shapes for applications where maximum resistance to deterioration by heat, oils, solvents and corrosive liquids is essential.

Viton is unequalled for service against oils and solvents at temperatures over 400 F, and is highly resistant to ozone and weather deterioration. Briefly, it offers the following advantages to users: —

(1) Gives good performance when exposed to dry heat, retaining its useful elasticity for more than 2,400 hr at

400 F (1,000 hr at 450 F).

(2) Resists most of the new lubricants, fuels and hydraulic fluids developed for jet aviation.

(3) Surpasses most other rubber compounds in its resistance to attack by acids and bases.

(4) Has good resistance to benzene, carbon tetrachloride, carbon disulfide, naphtha, turpentine, aniline, trichlorethylene, acetone and other solvents.

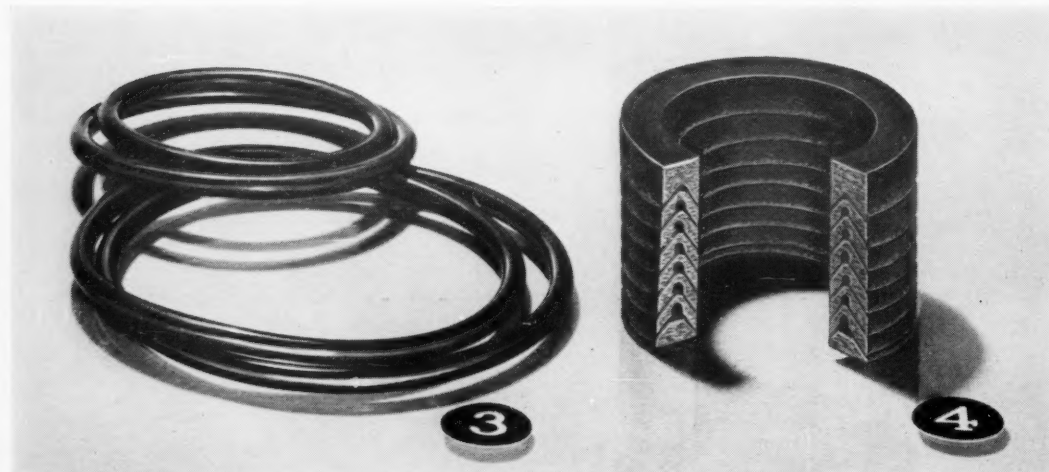
(5) Exhibits excellent mechanical properties in comparison with other heat and fluid-resistant rubbers.

(6) O rings, have performed satisfactorily at —65 F.

(7) Has good resistance to compression set.

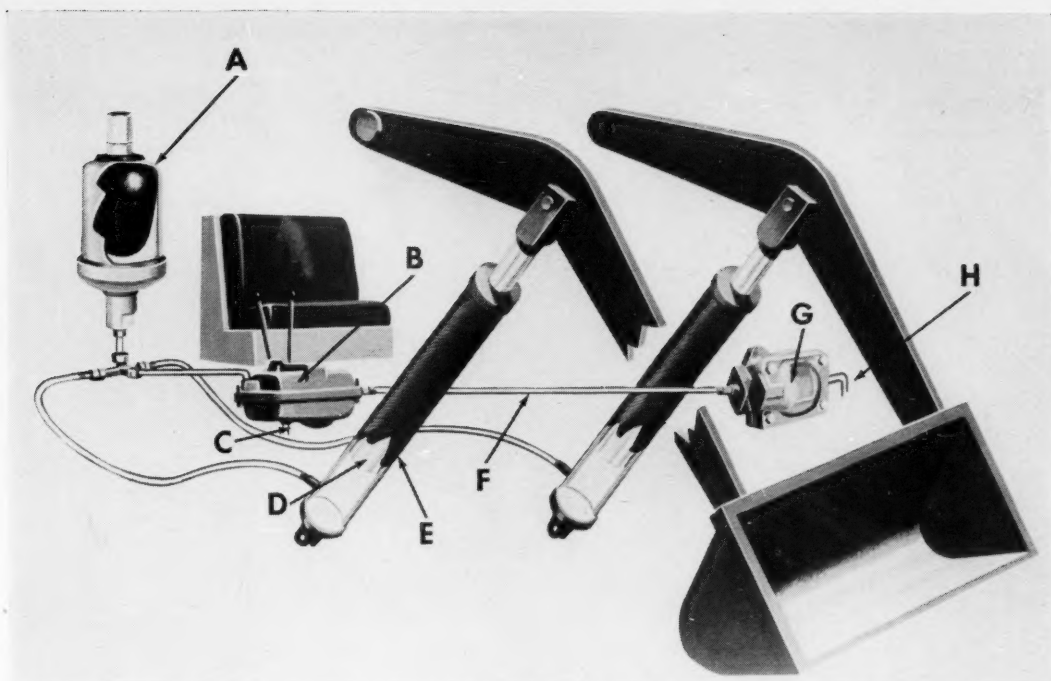
Garlock has designated its formulations as Styles 9663 at 60 durometer; 9466 at 70 durometer; 7592 at 80 durometer; 9659 at 90 durometer; and 7623 at 80 durometer. Style 7623 is an off-white Viton formula for use in the food industry. All other styles are black.

Style 9671 for O rings in military aircraft has unusual resistance to hot air and hydraulic fluids. ★



3. These are Viton "O" rings not vari-sized hula hoops. 4. Chevron packing of cotton duck impregnated with Viton.

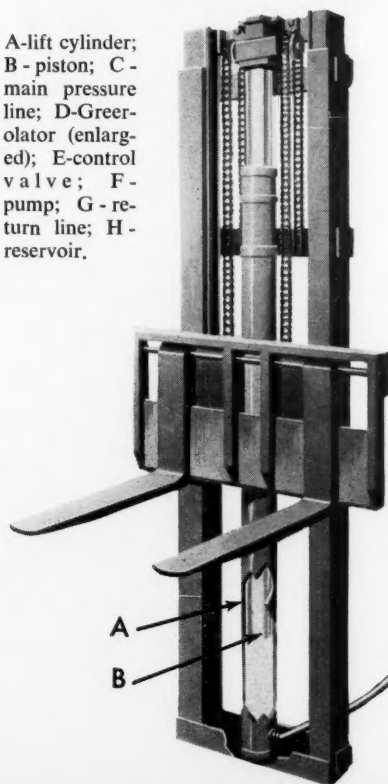




A-Greerolator (enlarged); B-control valve; C-reservoir line; D-piston; E-lift cylinder; F-line; G-pump; H-reservoir line.

## Small accumulator absorbs load shocks

A-lift cylinder; B-piston; C-main pressure line; D-Greerolator (enlarged); E-control valve; F-pump; G-return line; H-reservoir.



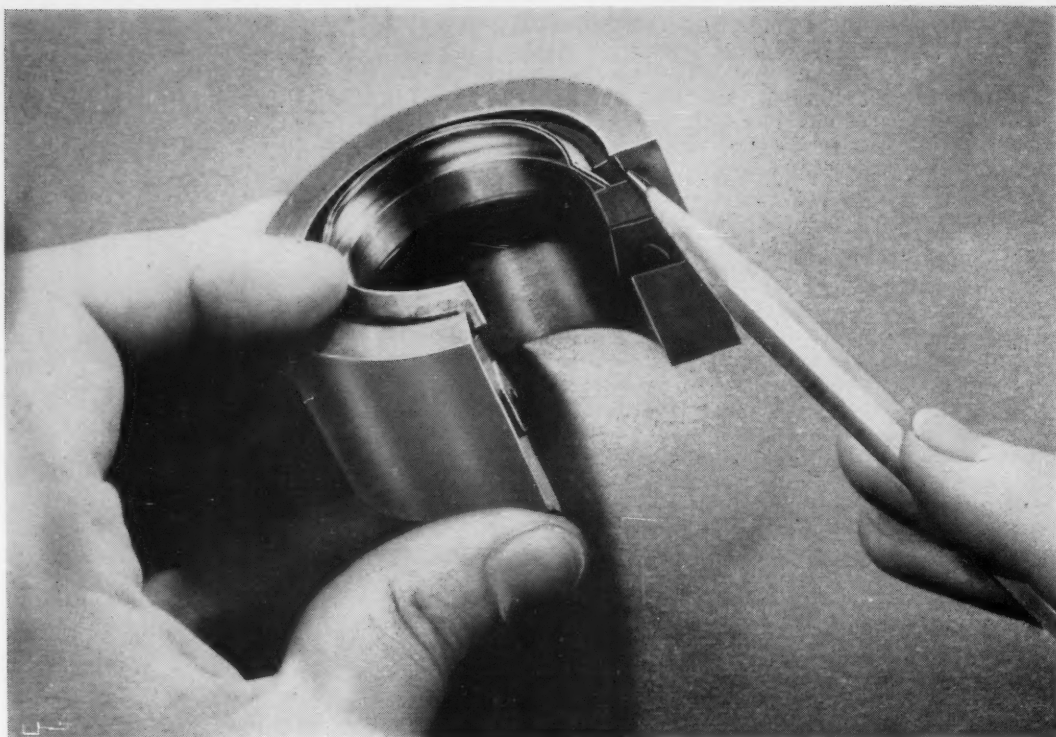
A light-weight, disposable hydro-pneumatic accumulator (designed to absorb shock and vibration on fork-lift trucks and bucket loaders) has been developed by Greer Hydraulics, Inc.

Manufactured in 1 qt and 1 gallon sizes, this new

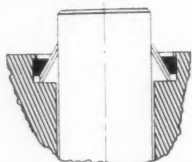
accumulator (the Greerolator) consists of a two-piece welded shell, a one-piece bladder and only three moving parts.

The accumulator can be installed on existing lift trucks and bucket loaders with very little effort. By eliminating damaging shock to cylinders, hose and other major hydraulic parts, the new accumulators will help to reduce maintenance and replacement costs.

The quart size has a diameter of  $4\frac{3}{4}$  in. and is  $11\frac{1}{4}$  in. long, while the gallon size diameter is  $6\frac{3}{4}$  in. and its length  $15\frac{9}{16}$  in. The Greerolator is designed for a working pressure of 2,000 psi, a proof pressure of 4,000 psi and a bursting pressure of 6,000 psi. It comes pre-charged with inert nitrogen gas. ★

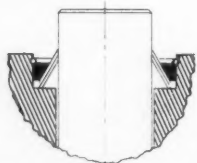


#### (A) How to install



Sketch (A) shows the most common method of application, in which a groove (similar to an "O" ring mounting) is cut in the cylinder wall. No retainers are required with such an installation. The metal rings should be installed with notches staggered. Then, using a dull tool, push one side of the rubber ring into the counterbore and repeat at intervals around the circumference until the entire ring is in its place under the retaining rim. A light film of oil on the surface is helpful and will not affect the rubber ring.

#### (B) Alternate method



Another method of retaining the unit is by the use of a snap ring arrangement as in (B). The proportions of the wiper remain the same.

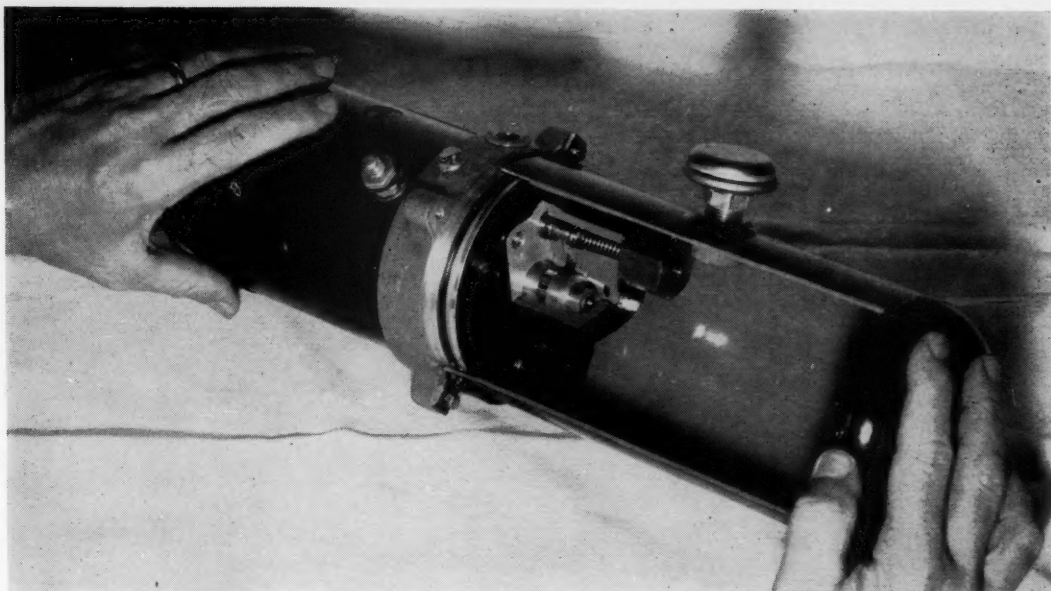
## Wiper unit keeps cylinder rod clean

A new type of wiping unit, for hydraulic cylinder rods operating in dirty areas, is reported by E. F. Houghton & Co., suppliers of the product.

Two bronze rings or blades fit snugly around the cylinder rod and seat in a recess machined into the gland ring. A rubber retaining ring snaps over the blades and down into the recess, holding the blades in place in an easily assembled unit. The rubber retainer also acts as a cushion, to absorb shock and side loads while providing an over-all outside unit seal.

Called the Houghton Seal-Guard, this two-bladed wiping unit will effectively clear dust, grit, weld spatterings, mud and ice from a reciprocating rod. These contaminants would otherwise be pulled back into the cylinder on each retraction of the rod, abrading packings, scoring cylinder walls, clogging screens and forming sludge in the hydraulic fluid.

The wiper is available in any size, from ½ in. to 24 in. shaft diameter. Sizes change in increments of 1/16 in. up to 6 in. diameter, and in increments of ¼ in. from 6 in. right the way through to 24 in. diameter.★



*Cutaway view of hydraulic power package shows pump housing contained within single-piece deep drawn reservoir.*

## Self-contained hydraulic power package

Self-contained power packages, producing hydraulic power from an electric source, are available from Wooster Division, Borg-Warner Corporation.

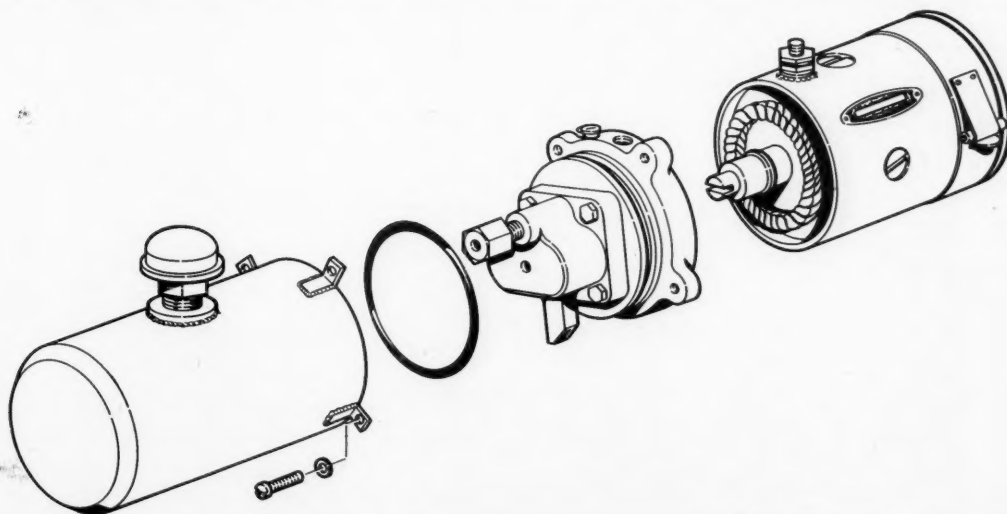
The unit consists of an electric motor, an hydraulic gear pump with integral relief valve, a check valve and a reservoir, all in one compact assembly. Pressure loaded bearings (a patented feature) automatically compensate for wear, and help give high volumetric efficiency and long life. A minimum of moving parts gives trouble-free operation and less maintenance.

The package is designed to handle a variety of work loads, including loads as great even as those encountered in heavy equipment like snow plows, tailgate

loaders, tractors and lift trucks. Capacity of the gear pump ranges from .36 to .80 gpm. Hydraulic control valves (furnished with integral relief and check valves) give perfect control of the load in lifting, lowering and holding positions, even in extreme cases of motor stall.

Reservoir capacities range from 0.43 to 1 gal. The reservoir also serves as the pump housing. It is made of a single piece of deep drawn steel.

The Wooster line of motors, developed specifically for this power package, may be open-ventilated, totally enclosed or standard starter-type motors. They are available for operation from a 6, 12 or 24 volt ac source. Rotation is in either direction or reversible. ★

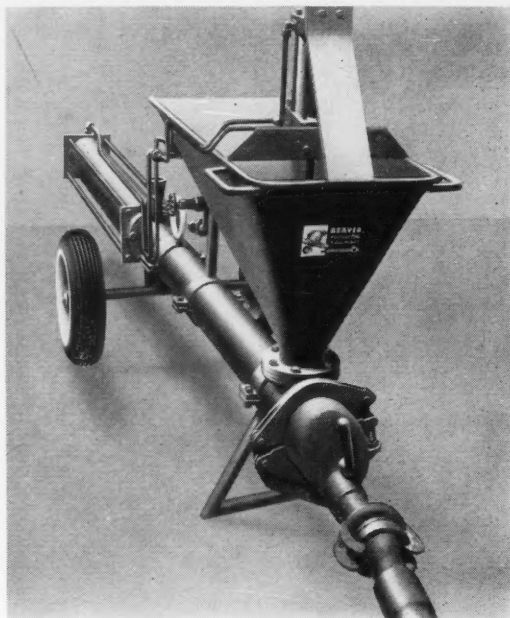


*Exploded view of unit containing electric motor, gear pump with integral relief valve, check valve and reservoir.*



*This 14-ft. manometer is used as a safety device in pressure testing parts of the 707 jet transport. (200)*

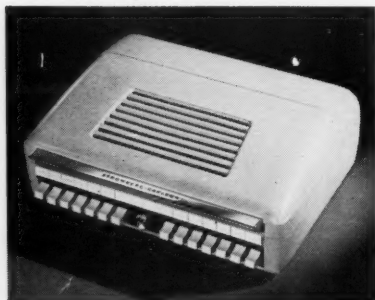
*Canadian-made grouter is just 45-in. high by 24-in. wide and provides high-capacity delivery. (203)*



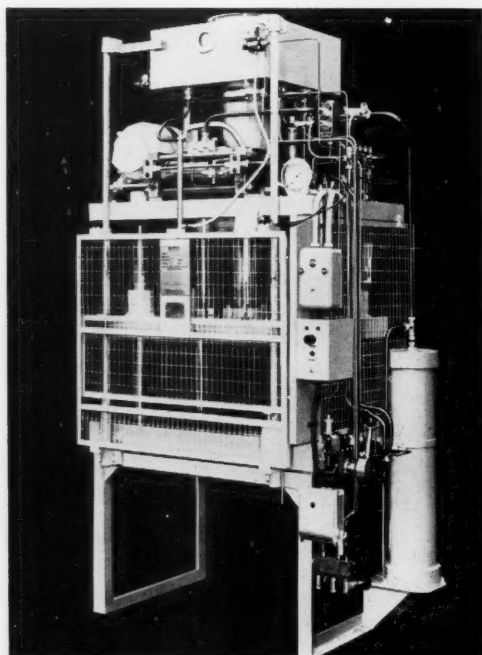
## Design news in pictures



*New double ratio bench counting scale can be toted for on-the-job use. (201)*

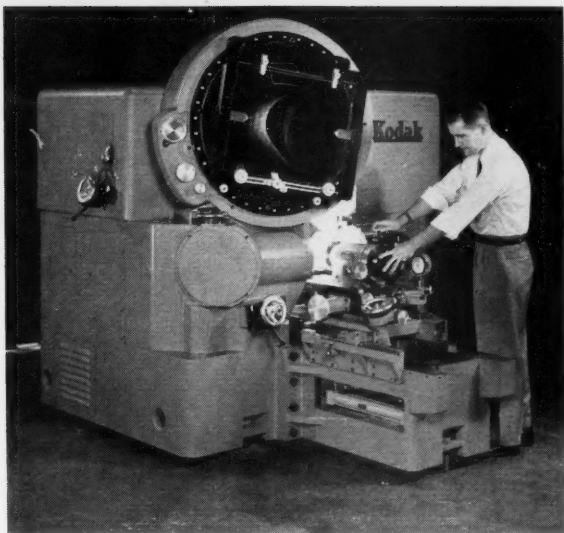


*Sleek, smart unit of the new "Key-Municator" intercom system. (202)*

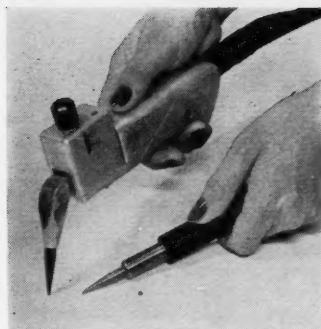


*Self-contained, semiautomatic downstroking 30-ton hydraulic flash clipping press for die-casting. (204)*

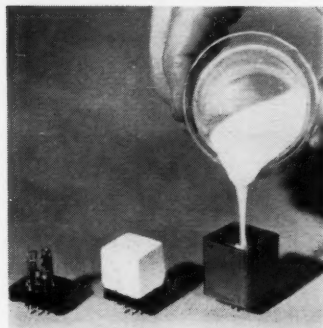




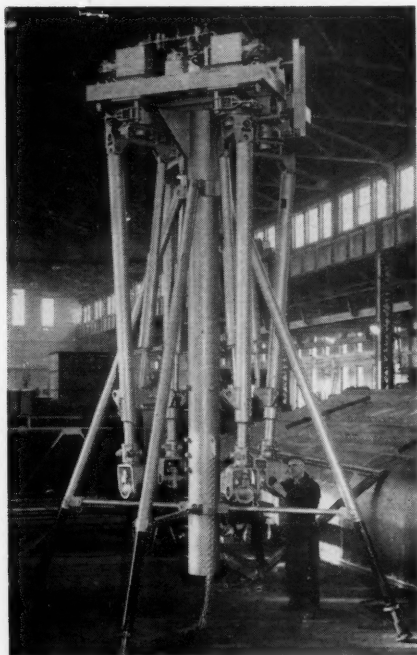
*This section-profile projector uses two beams of light for mass inspection of various turbine engine blading. (205)*



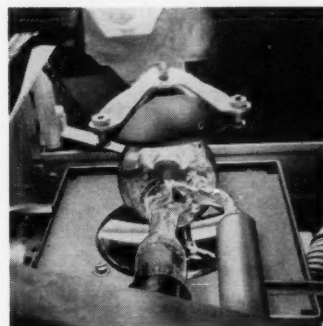
*Pressure-sensitive resistance probe for welding thermocouples. (207)*



*Stycast TPM-4 is the closest approach yet to castable Teflon. (208)*



*Canada's first shaft-sinking jumbo towers above man. Four drills extend to 10 ft. (206)*



*This cold light for cinemas uses xenon gas instead of carbon. (209)*



*Not ceramics but parts made or coated with Plasma arc torch. (210)*

## Calculating effective thrust loads

**A mathematician delves into the internal unbalanced forces of the axial piston pump — and then he comes up with three interesting solutions**

### NOMENCLATURE

- $a$  distance from reference axis to centroid (in.)
- $d$  diameter of pistons (in.)
- $F$  factor which depends on number of pistons and eccentricity of load
- $F_1$  factor which depends on eccentricity of load only
- $h$  maximum height of ungula wedge representing maximum load intensity on bearing
- $N$  total number of pistons
- $N_1$  number of pistons loaded
- $p$  discharge pressure of pump (psi)
- $p^i$  inlet pressure of pump (psi)
- $P$  total actual load on bearing (lb.)
- $P_e$  effective load on bearing (lb.)
- $r$  pitch radius of bearing (in.)
- $R$  pitch radius of pistons (in.)
- $y$  height of ungula at any point
- $\alpha$  variable central angle
- $\beta$  angle of load (as shown in Fig. 5)
- $2\lambda$  limit of load on bearing (as shown in Fig. 5)
- $\theta$  central angle between adjacent pistons
- $\delta$  angle between axis of pump body and axis of upper thrust bearing

**Norman M. Wickstrand** TORRINGTON CO.

The axial piston pump (one type of which is shown in Fig. 1) is plagued with internal unbalanced forces that are disturbingly contradictory to its symmetrical appearance. These unbalanced forces occur primarily because the pistons are not all under the same pressure. In spite of the unbalanced forces, the loads on all the bearings (except the upper thrust bearing) can be found by simple statics, and bearing selection made without any special considerations.

The load on the upper thrust bearing can also be found by statics. This load is not, however, applied at the centre of the bearing and its direction is not even parallel to the axis of the bearing. This results in a non-uniform load distribution on the rolling elements of the bearing which, if not considered in selecting the bearing size, might result in premature failure.

A method is developed here for computing the effect of eccentric loading on thrust bearings, particularly those immediately adjacent to the pistons in an axial piston pump. The method is based on these five assumptions:—

(a) Half the pistons are subjected to full discharge pressure, and the rest to zero gauge pressure. However, since most pumps have an odd number of pistons, the term "half" must be defined as a whole number of pistons on one side of an arbitrary reference diameter, which produces the worst thrust bearing load condition.

(b) The total load on the bearing equals the sum of the load components of the individual pistons, acting as a single load placed at the centroid of the loaded pistons.

(c) The bearing races are completely rigid, except for local elastic deflection at the areas containing the rolling elements. The deflection of each rolling

element (plus the local deflection of the contacting races) is proportional to the unit load applied to each rolling element.

(d) When the bearing is a needle thrust bearing (with its large number of rolling elements) the load distribution on the rolling elements can be represented as a smooth curve. The load intensity varies directly as its normal distance from an arbitrary reference chord.

(e) The limiting criterion for bearing service load is represented by the maximum height of that curved area. This is a measure of the heaviest load on any one roller or ball in the thrust bearing.

Fig. 1 shows how the centreline of the main pump body and the centreline of the upper thrust bearing are inclined at a small angle  $\delta$  to each other. Fig. 2 shows an exploded view of the pump pistons and upper thrust bearing, with the thrust components indicated for a five-piston pump. From (a), only two pistons are loaded, the individual piston loads being  $P_1$  and  $P_2$ . These loads are co-axial with each piston. The component of each piston load normal to the plane of the upper bearing is  $P_1/\cos \delta$  and  $P_2/\cos \delta$ . The angle  $\delta$  is the same as the angle of the wedge or ramp which is necessary in this type of pump. The angle is in the direction of the  $zz$  axis (see Fig. 2).

When the load is distributed as in (c) and (d), it can be represented by the shaded area shown. The load intensity is proportional to the deformation, which varies directly as the distance (measured along the  $xx$  axis) from the reference chord 00.

This shaded area can be described as the lateral area of an ungula (or wedge).

### Analyzing the problem

A careful study of the pump geometry shows that the pistons are placed along elements of a cylinder and that the lower piston tips are in a plane which is not normal to the axis of the reference cylinder. The trace of these tips is therefore, an ellipse. Since we are only interested in distances in the  $xx$  direction, no error is introduced by assuming this trace to be a circle. This is particularly true since we are studying distances transverse to the ramp angle and not up and down the ramp.

With an even number ( $N$ ) of pistons in the pump, the number under load may be either  $N/2$  or  $(N/2 - 1)$ . With an odd number of pistons the number of pistons under load may be either  $\frac{1}{2}(N + 1)$  or  $\frac{1}{2}(N - 1)$ . For any given number of pistons, it is necessary to evaluate both conditions to learn which is the more severe.

It can be shown that the critical condition will, in all cases, be where the pistons are located symmetrically about the  $xx$  axis. Fig. 3 represents this condition for an even number of pistons under load whilst Fig. 4 represents the same condition with an odd number of pistons under load.

The total load on the bearing may be obtained from one of the following four equations. The equation for the critical load is selected by trying both the first two (or both the last two) equations.

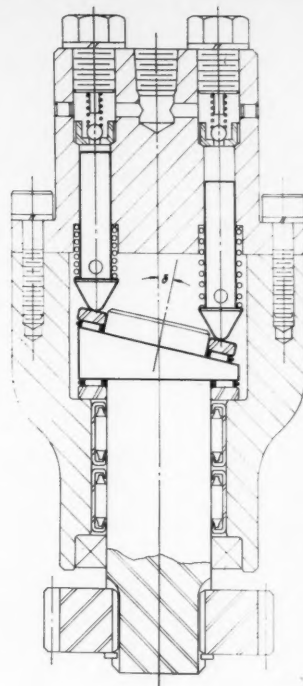


Fig. 1

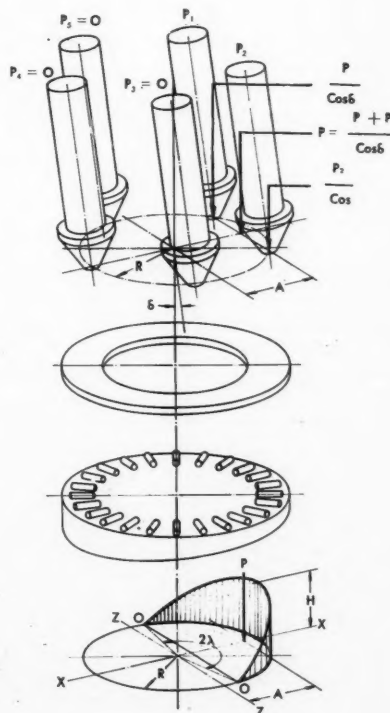


Fig. 2

When the total number of pistons is *even*:-

$$P = \frac{\pi d^2}{4} \cdot \frac{p}{\cos \delta} \cdot \frac{N}{2} \dots\dots\dots (1)$$

$$P = \frac{\pi d^2}{4} \cdot \frac{p}{\cos \delta} \cdot \frac{N-2}{2} \dots\dots\dots (2)$$

When the total number of pistons is *odd*:-

$$P = \frac{\pi d^2}{4} \cdot \frac{p}{\cos \delta} \cdot \frac{N+1}{2} \dots\dots\dots (3)$$

$$P = \frac{\pi d^2}{4} \cdot \frac{p}{\cos \delta} \cdot \frac{N-1}{2} \dots\dots\dots (4)$$

Eqn (2) represents the condition where two pistons are on the reference axis *zz*, but unloaded. This condition has less actual bearing load than if the two pistons were considered loaded, but produces a more critical loading condition on the bearing due to the eccentricity of the load.

The line of action of the resultant piston load (*P*) is not co-axial with the thrust bearing of the pump, but is located at a point which is the centroid of the centres of the loaded pistons. The distance from the reference axis *zz* of the bearing to this centroid is indicated by the dimension "*a*".

To compute "*a*" for any condition, the moments about the reference axis are equated. For each combination of total number of pistons and number loaded, a different equation must be set up and evaluated. For example, for a 9-piston pump loaded as in Fig. 3, the equation is:

$$Pa = \frac{\pi d^2}{4} \cdot \frac{p}{\cos \delta} \cdot 2R \left( \cos \frac{\theta}{2} + \cos \frac{3\theta}{2} \right) \dots\dots (5)$$

Inserting the value of *P* from Eqn (4) and remembering that  $\theta = 360/9 = 40$  deg, the equation reduces to:-

$$a/R = .7199$$

In a similar manner, all values for *a/R* are determined (see Table 1).

The load transmitted to the rolling elements of the bearing is distributed around a portion of the pitch circle, as stated in (d) and indicated in Fig. 2.

This load is distributed as in Fig. 5. The load intensity is assumed to vary directly as the normal distance from the reference chord. The curved surface of an ungula of a circular cylinder represents the load distribution. As mentioned before, the maximum height "*h*" of the ungula represents the load on the heaviest loaded roller or ball of the thrust bearing; it is used as a measure of the effective load on the bearing.

The load transmitted to the rollers (as represented by the ungula) must equal the load *P* applied to the bearing by the pistons. The centroid of the ungula and the centroid of the loaded pistons must coincide at a distance "*a*" if the sum of the moments about the *zz* axis is to be equal. In other words, both the moment of the ungula and the moment of the piston force about the axis must equal *Pa*.

An algebraic representation of Fig. 5 is:-

$$y = h - r \tan \beta (1 - \cos \alpha)$$

$$\text{and } h = r \tan \beta (1 - \cos \lambda) \dots\dots\dots (6)$$

Notice that a negative sign is used for  $\cos \lambda$ ; when  $\lambda$  is greater than 90 deg, the cosine is, of course, negative.

The two equations combine to:-

$$y = r \tan \beta (\cos \alpha - \cos \lambda) \dots\dots\dots (7)$$

Since *P* represents the curved area of the ungula of the cylinder:

$$P = 2 \int_0^\lambda y r d\alpha = 2r^2 \tan \beta \int_0^\lambda (\cos \alpha - \cos \lambda) d\alpha$$

$$= 2r^2 \tan \beta (\sin \lambda - \cos \lambda) \dots\dots\dots (8)$$

In a similar way, moments about the *zz* axis are equated to obtain:-

$$Pa = \int_0^\lambda y r^2 \cos \alpha d\alpha$$

$$= 2r^3 \tan \beta \int_0^\lambda (\cos^2 \alpha - \cos \alpha \cos \lambda) d\alpha$$

$$= r^3 \tan \beta (\lambda - \sin \lambda \cos \lambda) \dots\dots\dots (9)$$

By solving equation (8) for  $\tan \beta$  and substituting in (6), yields:-

$$h = \frac{P(\sec \lambda - 1)}{2r(\tan \lambda - \lambda)} \dots\dots\dots (10)$$

Assuming that the effective load (*P<sub>e</sub>*) on the bearing is equivalent to a uniform load of intensity "*h*" on the entire pitch circle of the thrust bearing:

$$P_e = 2\pi r h$$

Inserting the value of "*h*" from Eqn (10) gives:-

$$P_e = \frac{\pi P (\sec \lambda - 1)}{\tan \lambda - \lambda}$$

The effective load is proportional to the applied load, or:

$$P_e = F_1 P \dots\dots\dots (11)$$

where *F<sub>1</sub>* is a correction factor.

Therefore, the value for *F<sub>1</sub>* in terms of angle only is:-

$$F_1 = \frac{\pi (\sec \lambda - 1)}{\tan \lambda - \lambda} \dots\dots\dots (12)$$

Equations (8) and (9) may be combined to eliminate  $\tan \beta$  and *P*:-

$$\frac{a}{r} = \frac{\lambda - \sin \lambda \cos \lambda}{2(\sin \lambda - \lambda \cos \lambda)} \dots\dots\dots (13)$$

Equations (12) and (13) are expressions for *F<sub>1</sub>* and *a/r* in terms of  $\lambda$ . These equations cannot be combined to eliminate  $\lambda$  but can be solved numerically.

Table 2 gives representative values of solutions which cover the complete range of probable values in axial piston pumps. For any given value of *a/r*, the corresponding value of *F<sub>1</sub>* may be found. Values of angle  $\lambda$  are also given. Other values may be found by interpolation.

In the preceding derivation it has been noted that dimension "*a*" must be the same for both the thrust bearing and the pistons. The value of "*a*" for any desired pump can be found by using a value

of *a/R* from Table 1 and then computing  $\frac{a}{r}$  for the bearing, obtaining the correct factor *F<sub>1</sub>* from Table



2. If the value of a  $a/r$  is less than 0.5, then  $F_1$  can be computed from the formula:—

$$F_1 = 1 + \frac{2a}{r} \dots\dots\dots(14)$$

The derivation of Egn(14) when  $a/r$  is less than 0.5 is of a similar nature to that of Egn(12).

In most pumps, the pitch diameter of the pistons and the pitch diameter of the thrust bearing are the same, or nearly so. When this is the case, values of  $F_1$  for each condition can be computed as in Table 1

1 The calculations are further simplified as follows:

$$P_e = \frac{F_1 \pi d^2}{4} \frac{p}{\cos \delta} N_1 \dots\dots\dots(15)$$

Let  $F = \frac{\pi}{4} N_1 F_1 \dots\dots\dots(16)$

Then equation (15) becomes:—

$$P_e = \frac{F p d^2}{\cos \delta} \dots\dots\dots(17)$$

The use of corresponding pairs of values of  $N_1$  and  $F_1$  from Table 1 will determine the worst condition for any probable number of pistons. These conditions are indicated by asterisks. Using only the worst conditions gives the values shown in Table 3. These values (used in Eqn (17)) provide a simple method of computing the maximum effective load on any axial piston pump when the two pitch diameters are approximately equal. That table gives the proper factor for the worst conditions only. Fig. 6 shows the factors for all angular positions of shaft through 75 deg of rotation. It illustrates that the effective bearing load is more uniform for an odd number of pistons than for an even number.

**Worked example:** Sometimes the inlet pressure is not zero, as stated in (a). A slightly different treatment is then necessary. The solution of this condition can be best explained by an illustrative example which (at the same time) shows some of the details previously mentioned. Assume a pump with seven pistons each .750 in. diameter on a 2.125 in. pitch diameter. The wedge angle is 13 deg, inlet pressure 400 psi and discharge pressure 950 psi.

Whenever the inlet pressure is more than about 1% of the outlet pressure, the critical loading on

the bearing occurs when  $\frac{N}{2}$  or  $\frac{N+1}{2}$  pistons are

subjected to the outlet pressure.

Since the inlet pressure must be considered in this example, more general forms of Eqns (3) and (5) must be used.

$$P = \frac{\pi d^2}{4} \frac{p}{\cos \delta} \frac{N+1}{2} + \frac{\pi d^2}{4} \frac{p_i}{\cos \delta} \frac{N-1}{2} \dots\dots(3a)$$

$$Pa = \frac{\pi d^2}{4} \frac{p}{\cos \delta} 2R \left( \cos \frac{\theta}{2} + \cos \frac{3\theta}{2} \right) - \frac{\pi d^2}{4} \frac{p_i}{\cos \delta} (1 + 2 \cos \theta) R \dots\dots\dots(5a)$$

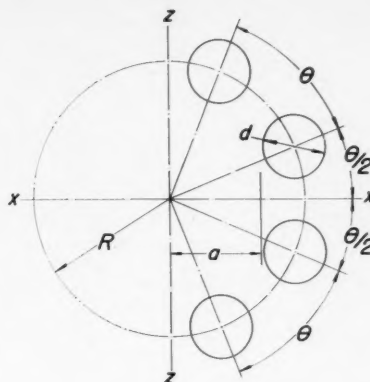


Fig. 3

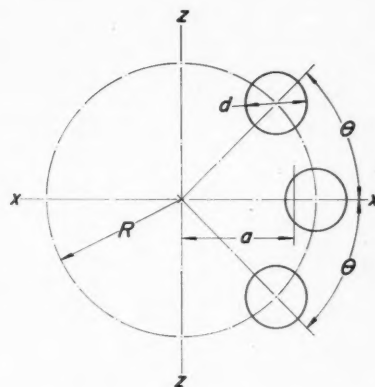


Fig. 4

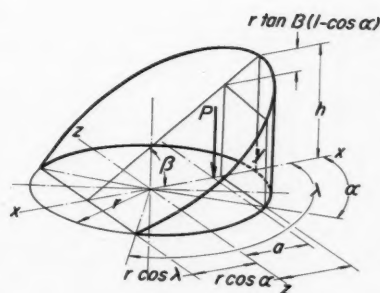


Fig. 5

## Axial piston pumps continued

Simplifying (3a) and (5a) and substituting the values from this example gives:—

$$P = \frac{\pi}{4} (.750)^2 \frac{1}{\cos 13} (950 \times 4 + 400 \times 3) \\ = 2270 \text{ lbs.}$$

$$Pa = 2270a = \frac{\pi}{4} (.750)^2 \cdot \frac{2.125}{2 \cos 13}$$

$$[2.950(\cos 25.71 + \cos 77.14) - 400(1 + 2 \cos 51.43)] \\ Pa = 595 \text{ Therefore } a = .263 \text{ in.}$$

Due to the appreciable inlet pressure, it is apparent that the effective centre of the load is fairly near to the centreline of the pump and bearing. Using a Torrington NTA-3648 needle thrust bearing (which has a pitch radius of 1.290 in.) the equation can be written:—

$$a/r = .263/1.290 = .204$$

Using equation (14) for  $F_1$ :

$$F_1 = 1 + 2a/r = 1 + 2 \times .204 = 1.41$$

The effective load can be found from equation (11):

$$P_e = F_1 P = 1.41 \times 2270 = 3200 \text{ lb.}$$

If the inlet pressure had been neglected (or if it had been zero) the effective load on the bearing could be obtained as follows:

From Table 1 for 7 pistons,

$$a/R = 0.7490, \quad R = 2.125/2$$

$$= 1.062 \text{ in.}$$

$$a = 0.7490 \times 1.062 = 0.796 \text{ in.}$$

$$r = 1.290 \text{ in.}$$

$$a/r = 0.796/1.290 = 0.617$$

Then interpolating in Table 2:

$$F_1 = 2.311$$

Using equation (15) yields:

$$P_e = \frac{\pi}{4} (.750)^2 \cdot 3 \cdot \frac{950}{\cos 13} \cdot 2.311 = 2990 \text{ lb.}$$

Of course, by assuming that the pitch diameter of the pump and the bearing are essentially equal, the calculation is even more simple. Then eqn (17) and the proper factor for 7 pistons from Table 3 apply:—

$$P_e = 6.82 \cdot \frac{950}{\cos 13} \cdot (.750)^2 = 3740 \text{ lb.}$$

## Conclusions

The above solutions illustrate three conditions under which effective loads may be computed for axial piston pumps. The first (or longest method) will rarely be applicable. The third (or shortest method) will give a larger or more conservative load when the bearing pitch diameter is greater than the pitch diameter of the pump pistons. ★

TABLE 1

Total number of pistons $N$	Even number of pistons loaded				Odd number of pistons loaded			
	No. of loaded pistons	$\frac{a}{R}$	$\lambda$	$F_1$	No. of loaded pistons	$\frac{a}{R}$	$\lambda$	$F_1$
	$N_1$				$N_1$			
5	2	.8090	84.10	*3.340	3	.5393	154.20	2.089
6	2	.8660	68.96	*4.018	3	.6667	118.50	2.487
7	4	.5617	146.57	*2.146	3	.7490	98.74	*2.895
8	4	.6533	121.80	2.435	3	.8047	85.21	*3.301
9	4	.7199	105.70	*2.731	5	.5759	142.29	2.184
10	4	.7694	93.87	*3.026	5	.6472	123.27	2.413

\*Values used to compute factors in Table 3.

TABLE 2

$a/r$	.50	.55	.60	.65	.70	.75	.80	.85	.90
$\lambda$	180.0	150.4	135.5	122.6	110.5	98.6	86.4	73.5	59.0
$F_1$	2.00	2.115	2.254	2.423	2.631	2.899	3.260	3.785	4.661

When  $a/r$  is .5 or less  $F_1 = 1 + 2a/r$

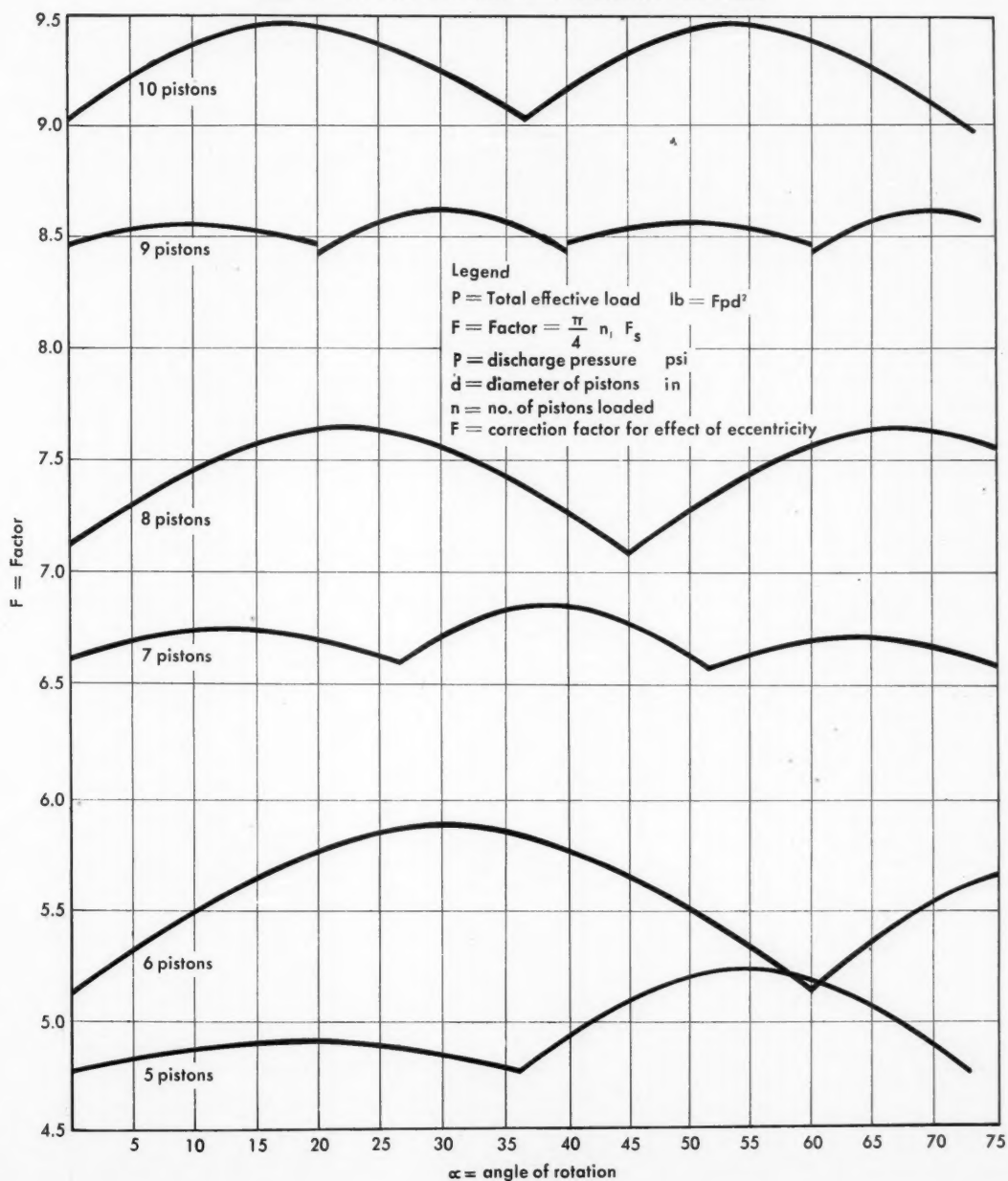
TABLE 3

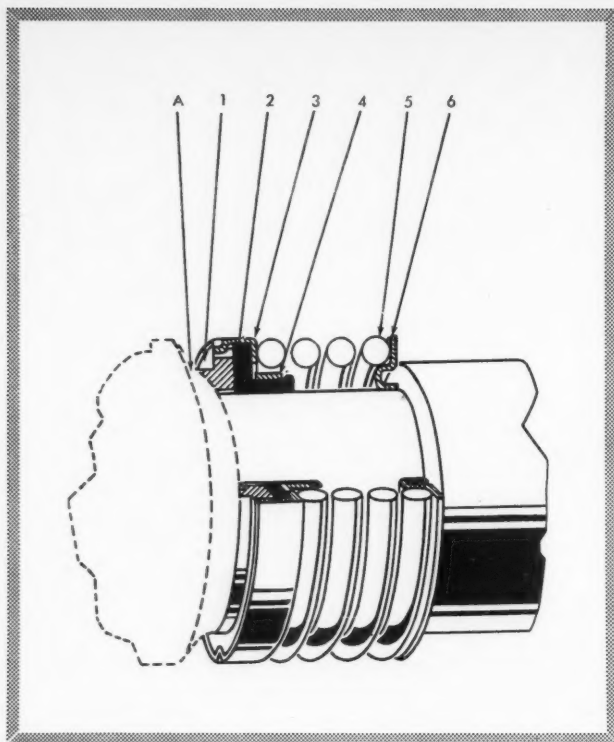
No. of Pistons	5	6	7	8	9	10
$F$	5.25	6.31	6.82	7.78	8.58	9.51

## Axial Piston Pumps

Fig. 6

THIS GRAPH IS REFERRED TO AS FIG 6 IN THE ARTICLE ON  
AXIAL PISTON PUMPS IMMEDIATELY PRECEDING THIS PAGE.





- (A) Stationary seal seat**
- (1) seal face**
- (2) friction ring**
- (3) retaining shell**
- (4) friction ring band**
- (5) spring and**
- (6) spring holder**

## Rotary seal: six-piece success story

**Rotating with the shaft this radial mechanical seal is a practical method of retaining gases, oils or other categories of liquids under pressure**

The rotary seal made by the Rotary Seal Division, Muskegon Piston Ring Company is a practical method of retaining gases, oils or other liquids under pressure. It has been successfully used on every type of rotating shaft arrangement. This radial (or face-type) mechanical seal rotates with the shaft, a typical assembly consisting of:

- (A) Stationary seal seat,
- (1) seal face,
- (2) friction ring,
- (3) retaining shell,
- (4) friction ring band,
- (5) spring and
- (6) spring holder.

**How the rotary seal assembly works:** Contact between the surface of the seal face (1) and the mating stationary seal seat (A) forms a running joint. Pressure of the spring (5) holds the seal face tightly against the stationary seal seat. Internal gas or liquid bolsters this pressure. Flatness and smoothness is so exact that no gas or liquid can escape.

The back of the seal face rests against the front surface of the resilient friction ring (2). The friction ring

band (4) fits around the hub of the friction ring and restricts its expansion.

The retaining shell (3) fits snugly over the flanged portion of the friction ring and loosely encircles the seal face. Keys on the retaining shell engage in corresponding lateral grooves in the outer periphery of the seal face. This keying arrangement (combined with the resiliency and snug fit of the friction ring on the shaft and in the retaining shell) gives a positive yet simple, flexible driving connection.

The spring (encircling the shaft) is compressed to a predetermined length between the back wall of the retaining shell and the spring holder (6), which may rest against any part of the shaft or any member fastened to the shaft. The pressure developed holds the seal face in perfect sealing contact with the stationary seal seat, and also provides the force necessary to form a gasket joint between the friction ring and the back of the seal face.

Only one part (the soft, elastic friction ring) is securely fastened to the shaft. This allows the seal face to adjust its running plane freely to compensate for any shaft vibration, deflection, lateral play or slight misalignment that may break the running seal joint. ★



The Canadian Chromalox Co., Ltd., Toronto, Ont., manufactures electric immersion heaters in a variety of types and sizes for both industrial and domestic service. For many models Chromalox uses Noranda  $\frac{3}{8}$ " and  $\frac{1}{2}$ " temper-drawn copper tube.

**HOW THEY ARE MADE** — The resistance wire coil is centered inside the copper tube and surrounded by magnesium oxide powder insulation. Next, the tube is swaged throughout its entire length to compact the powder. The tube is then bent to the desired shape and fitted with terminals suitable for the device in which it is used. The bending operation is a critical one and often closer than usually recommended for the size of tubing.

**MEETING THE REQUIREMENTS** — Consequently, Chromalox has had to establish rigid specifications for the tube. It must be supplied temper (half-hard) drawn to make it sufficiently rigid to stand up under the initial fabrication processes, yet pliable enough to stand swaging and bending. Dimensional tolerances on diameters and wall thickness are also important and are closer than usual commercial practice.

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## Ideas round-up

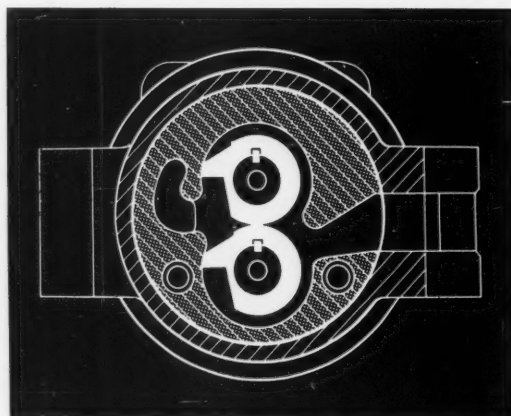
### Hydraulic pump: high torque at slow speeds

Model A pumps made by Berry Hydraulics can operate on surge pressures to 3,000 psi and continuous operating pressures of 2,000 psi. The pumps are designed for capacities from 7.5 to 12 gpm, at a rated speed of 1,200 rpm.

Motor characteristics are: Maximum torque at stall, and constant torque output with a flat characteristic curve from 0 to maximum designed rpm, are among the many outstanding advantages. The motors have anti-friction bearings throughout and are capillary sealed between all rotating parts. The motors are instantly reversible and will carry overhung chain or belt loads.

The high torque at slow speeds permits direct connection, without gear or belt reduction.

The rotary piston design (with no wearing surfaces) results in high overall efficiencies throughout the life of the unit. (211)



### Oil seal: an expanded use of auto-transmission type

Apparatus originally designed by Victor Manufacturing and Gasket Co., to test the automatic-transmission oil seals of cars may be used to qualify any lip type shaft seal.

Each unit consists of a shaft, a housing, the seal under test and a variable speed drive. Shaft eccentricity is created by boring the shaft off centre and

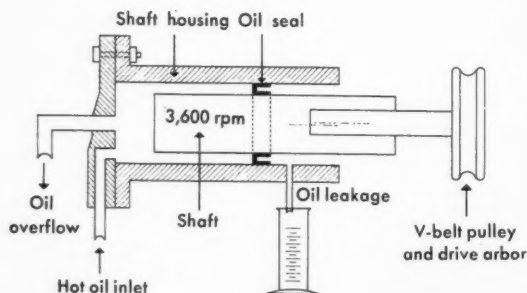
inserting an arbor on the drive end. Angular and lateral misalignment are created by adjusting screws on the housing. The shaft, concurrently with its rotation, reciprocates  $\frac{1}{8}$  in. every 5 minutes. In most of the tests, the shaft speed is 3,600 rpm and oil temperature 280 F.

The exact amount of misalignment and eccentricity depends on the kind of seal being tested. In any case, the test must simulate conditions of faulty installation and wear.

The test is run 16 hrs. a day for 300 or 1,000 hrs. The 8 non-operating hours each day allow the shaft to cool and contract, just as would occur in an actual automobile. If the seal is not sufficiently resilient, leakage will occur during these periods.

Under these operating conditions, the total oil leakage should not exceed 4cc in the 300 hr. test, 40 cc in the 1,000 hr. test. Victor engineers equate 100 hr. on their test to 10,000 miles on an automatic transmission. Hence, their seals are designed to operate virtually leakproof for almost the life of the transmission.

Early seal designs frequently failed physically in the lab but now this is a real rarity. Test failures are limited to excessive leakage without apparent damage to elastomer. Correlation between service and lab, therefore, has been made solely on the basis of loss of transmission fluid. (212)



Test apparatus subjects oil seals simultaneously to various difficult operating conditions — shaft eccentricity, misalignment, sliding, high speed — simulating typical oil seal service as an actual shaft in automatic transmission wears. 100 test hours equal 10,000 miles.

## REPRESENTING . . .

<b>MEAD—</b>	single and double acting cylinders, drill press feeds, rotary and reciprocating feeds, index tables, collet fixtures, air presses, impact hammers, timers, controls, valves and fittings.
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<b>CLIPPARD—</b>	miniature air cylinders, controls, valves, fittings.
<b>PNEU-TROL—</b>	flow controls, needle and check valves, time delay switches.
<b>HASKEL—</b>	air and hydraulic test stands, compressors, environmental test equipment, gas boosters, pump units.
<b>HUNT—</b>	"Quick-as-wink" controls, valves, couplings, unions.
<b>IMPERIAL—</b>	tube fittings, pressure hose, couplings, tubing tools.
<b>ALKON—</b>	cylinders, controls, valves, air and hydraulic drill feeds.
<b>APPCO—</b>	hydraulic checking cylinders.
<b>INDUSTRIAL—</b>	air rotary torque motors.
<b>SAVAGE—</b>	air poppets, rotary tables.
<b>STUDEBAKER—</b>	air-hydraulic presses, power packages, vises, foot pumps, pressure testers.

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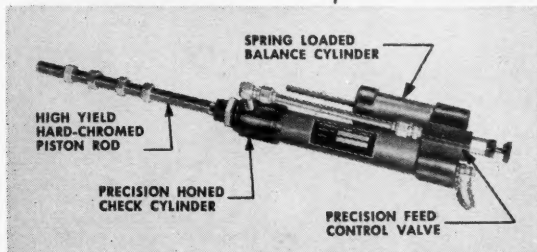
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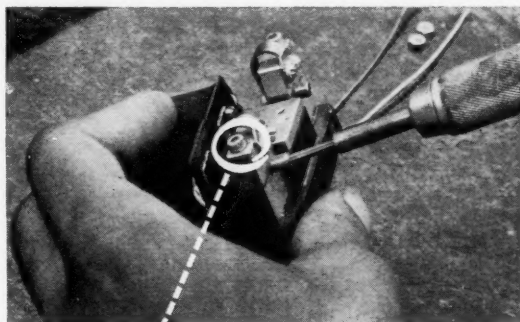
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## Bellows shaft seal: has Teflon face and resists potent chemicals



A bellows-type end-face shaft seal (in which only chemically inert DuPont Teflon is exposed to the liquid being sealed) has been announced by Crane Packing Company. Known as Type 20, it was designed for use where: (1) potent chemicals increase the corrosion rate of seal parts normally made of metal (such as springs), to such an extent that the seal life is very short; and (2), chemicals prone to crystallization inhibit the flexibility of a shaft seal.

The main sealing member of the new shaft seal is a bellows of pure Teflon integrally molded with a sealing face of filled Teflon. The sealing face material (and the opposed mating face material) can be varied to suit specific liquids, temperatures and pressures. Even the springs that maintain contact between the sealing faces are Teflon-sleeved, so that no metal is exposed to the liquid, even when the seal is internally mounted.

For internal mounting, a double-ended seal is employed, a sealing face being integrally molded to both ends of the bellows. The entire assembly is floated between the opposed sealing faces. For external mounting, a single-faced seal is used and the rotating member secured to the shaft with a metal clamping ring.

Sizes for both types run from  $\frac{3}{4}$  to 2 in., with design provisions to compensate for dimensional discrepancies encountered in chemical and similar pumps. (213)

## Flush valve: glassed head is a triple benefit

Pfautler flush valves for the bottom outlet of glassed-steel reactors give maximum protection against corrosion and use a one-piece glassed head and stem, with a glass-filled Teflon seat to reduce maintenance and minimize product build-up.

The valve is designed to operate under the same conditions as glassed-steel process equipment, in terms of chemical service, temperature and pressure. It offers these design advantages:—

Glass is used on the head and stem assembly and on product contact surfaces inside the valve body.

It provides resistance to all acids (except hydrofluoric), even at elevated temperatures and pressures, and to alkalis at moderate temperatures. Chevron-shaped solid Teflon rings (used for packing) have a high corrosion resistance and keep maintenance low because of their low friction against glass.

The valve uses internal tank pressure plus mechanical pressure to achieve a leaktight seal. The stem extends up through the inlet opening, thus holding the head above the seat, rather than away from it. In opening, the head moves up, breaking through the layer of residue, often present in the bottom of the tank.

The valves can be used under either pressure or vacuum, and are available in six sizes. (214)



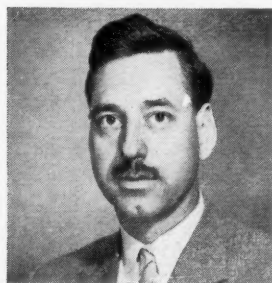


## People in the news

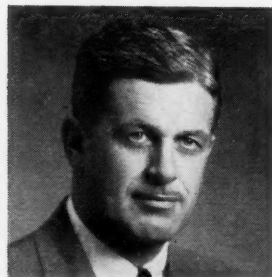


Dominion Bridge Company announces the appointment of E. Ross Graydon as manager of their Ontario division.

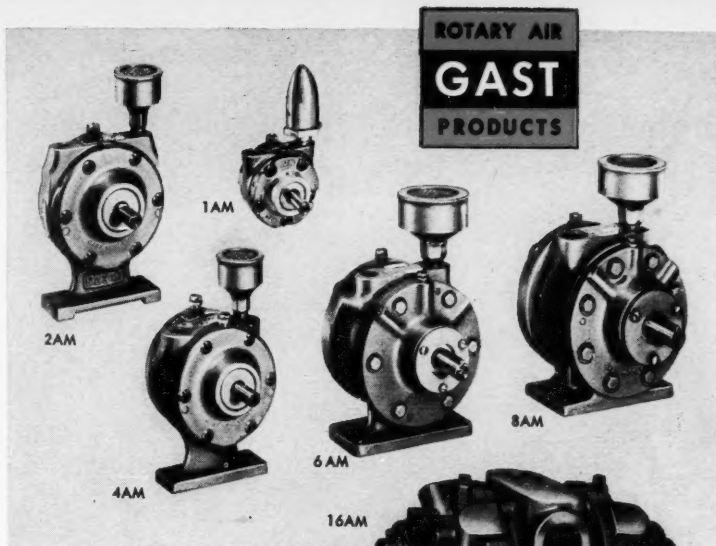
Prominent in engineering and accident prevention circles, Mr. Graydon is past chairman of the Toronto branch of the Engineering Institute of Canada.



John Wilkes, P.Eng., has been appointed Planning Engineer, Ontario Department of Highways. Mr. Wilkes graduated from U of T and joined the Department of Highways in 1949 in the Hamilton district. Since then he has served as construction engineer and district engineer in various Ontario districts.



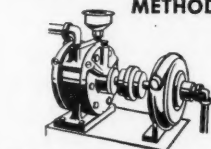
The Board of Directors of the Institute of Radio Engineers recently announced the election of A. P. H. Barclay as director of its Canadian region. Mr. Barclay is general manager, Engineering and Manufacturing of Philips Electronics Industries, and well known professionally.



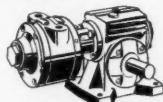
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## GAST ROTARY AIR MOTORS

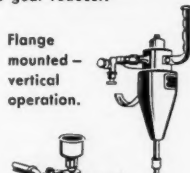
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9. Ball-bearing; almost service-free design.
10. Mechanically simple, neat in appearance.

Gast Air Motors are supplied as original equipment on pneumatic hoists, mixers for paint and chemicals, fans, blowers, fuel hose-reel rewinders, liquid pumps, spooling machines and a host of other products. Used in explosive atmospheres and in "hot" locations to 250° F.

Model No.	1AM	2AM	4AM	6AM	8AM	16AM
H.P. at 90 P.S.I., 2000 RPM	0.13	0.57	1.1	2.0	4.0	7.0
Weight, lbs.	1½	5½	8	17	25	65

For complete performance data, write for *Air Motor Bulletins*. Specify models that interest you.

GAST MANUFACTURING CORP., P.O. Box , Benton Harbor, Michigan  
SEE CATALOG IN SWEET'S PRODUCT DESIGN FILE & A.S.M.E. CATALOG

**GAST  
ROTARY**

- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

"Air may be your answer!"

Circle number 120 on time saver card

### Hydraulic cylinder: comes from stock components

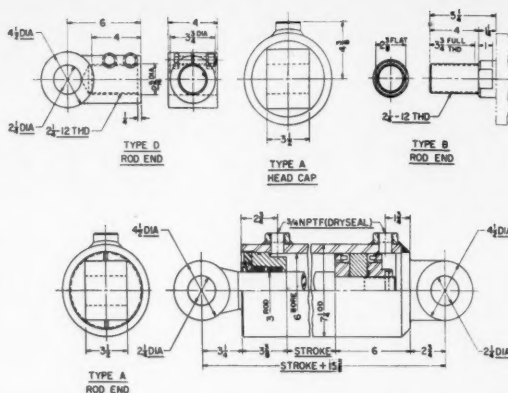
Hydraulic cylinders for industrial applications, assembled from a variety of standard rod ends and head ends to suit specific needs, are available from Wooster Division, Borg-Warner Corporation.

Offering a choice of up to five rod ends and two different head ends for any type of cylinder, the new units provide a flexible selection. When assembled from basic stock components, the units give optimum performance for specific applications. The cylinders cover a wide range of styles and working pressures. Industrial uses include agricultural equipment, road building equipment and lift trucks for heavy-duty applications and precision machinery for fine control.

Double-acting and single-acting cylinders are available for both general and special purpose applications. Single-acting cylinders are offered in either the piston style or displacement style; double-acting units are available in piston style only. Working pressures range from 1250 to 3000 psi with intermittent working pressures up to 4000 psi tolerated in some of the double acting cylinders.

The working stroke of the cylinders ranges from a minimum of 6 9/16 in. (for the general purpose double acting cylinder) to a maximum of 22 in. (for the special purpose unit). Effective push areas range from 1.76 to 50.26 sq. in., while pull areas from 1.32 to 21.21 sq. in. may be selected. Bore diameters ranging from 1½ to 6 in. can be matched with rod ends from ¾ to 4½ in. diameter.

Both standard and heavy-duty solid piston rods are made from C-1141 high strength alloy steel, ground, polished and hard chrome finished. Hollow rods are of alloy steel tubing. Packing rod glands have V pack-



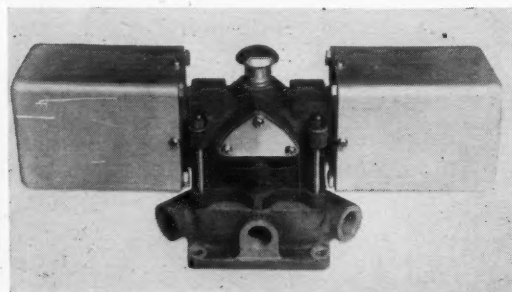
ing, while pistons have leather U cups and are suitable for either high or low temperature operation. Heavy wall, seamless steel tubing is used for the cylinder barrel, with cylinder walls honed to a highly accurate finish for minimum friction and wear.

Special purpose double-acting hydraulic cylinders are fitted with double section piston rods. This design permits passage of oil to both ends of a double-acting cylinder, but does not require hose connections to the cylinder barrel. This arrangement allows the rod to be fixed while the barrel section reciprocates. These special purpose double-acting cylinders are in fact, well suited to any installation where it is impossible to make hose connections to the cylinder barrel. Units for use with fire-resistant fluids are also available. (215)

### Solenoid valve: replace it in a minute

An electrically actuated pneumatic valve has been designed with quick disconnect features for easy servicing and instantaneous replacement in automatic machines.

Manufactured by Whittaker Controls (a division of Telecomputing Corporation) the plug-in valve conforms to JIC standards and provides an efficient control device for automation set-ups using shop air.



Since the entire valve mechanism may be replaced in less than a minute, simply by plugging a new valve body on to its base and tightening 4 nuts, valve failure is almost eliminated as a source of production trouble.

Trade-named Model P/N 220155, the valve (made of die-cast aluminum) is a 4-way, 3 position solenoid-actuated unit rated at 100 psi service pressure and operated by 115 volt 60 cycles ac. It has been tested for several million cycles of operation without malfunctioning. Port sizes are 1/2 in. NPTF dry seal throughout.

The valve has two parts: the base (or manifold) and the body (or operating assembly). The base is permanently attached in place and its fluid lines are connected by conventional pipe threads; electrical leads are attached to a junction box forming an integral part with the base. The valve body is equipped with electrical prongs that fit into a female socket, while the body's fluid passages abut against corresponding openings at the base. By tightening 4 nuts which fasten the valve body, a set O-Rings at the base is compressed, thus obtaining leakproof seals. (216)

## Briefs

### We note with interest . . .

that high vacuums, temperatures up to 2700 deg F and fast response in heat treat and brazing cycles can be obtained from new Canadian General Electric bell-type furnace . . . . . Rocketdyne's Ion rocket engine will use a chemical propellant whose molecules offer the highest possible weight . . . . . electronic refrigeration is now no longer a laboratory curiosity and Westinghouse engineers have come up with some interesting ideas . . . . .

early in this year a collection of theoretical papers in aerodynamics issued by Aerodynamics Institute of the USSR will be published by the Pergamon Press . . . manufacturing synthetic oils and greases for applications that range from parking meters to man-made moons is job performed by Lehigh Chemical Co. . . . new vehicle takes swamp and muskeg in its stride — and features very light metal construction with balloon-type rollers to get it over rocky terrain too. Albee Rolligon Co. produce it. After 55 years the GE-Review has been discontinued with Vol. 61 No. 6 and one of the reasons is the 979 U. S. publications independently published are in industrial technology . . . more than 100 booths have been reserved for the 1959 Corrosion Show to be held March 17-19 at the Sherman Hotel, Chicago . . . . .

J. R. Hammond of Molded Fiber Glass Body Co. said at SAE National Transportation meeting held in Baltimore, Maryland, Oct. 20-23, that use of fiber-glass reinforced plastic in the automotive industry is steadily increasing . . . . . also that Italy has a vigorous plastics industry: in 1950 industrial consumption of plastics in Italy was 28 million lb.—in 1957 it had zoomed to 244 million pounds weight . . . . .

staggering news from London, Eng. is that a new high-speed electronic computer now being constructed, will be able to scan the 24-vol "Encyclopaedia Britannica" in less than four minutes . . . announcement by Mallory-Sharon Metals Corp., Niles, Ohio, that titanium sheet is now being used in the plating and chemical industries . . . . .

at International Conference on Scientific in Washington, D.C., Nov. 17-21, the Kodak Minicard system (ultra high speed information handling system) went on public display for the first time . . . . . nonflammable and nontoxic solvents are being used to reduce downtime of large electric motors to permit cleaning, say Du Pont of Canada . . . . .

*Continued on page 59*

DESIGN ENGINEERING JANUARY 1959

## SEALING DOMESTIC APPLIANCES IS A REAL CHALLENGE, TOO!

**Standard 6A Seal with specially designed seat conforming to impeller contour so as to promote good water flow characteristics.**

**Limited axial room and large diameter are mechanical requirements in this washing machine seal. Design features multiple spring construction for even face loading.**

**FIVE ADAPTATIONS OF THE John Crane TYPE 6A SEAL for four different appliance manufacturers**

**Seal features outer periphery face construction to best service garbage disposal conditions.**

**Two sealing points in a washing machine with widely differing physical limitations, yet seals for both retain full advantage of diaphragm action, shouldering points and positive drive.**

Soapy water, detergents, bones, grit

and lint . . . all these combine to make appliances a hard-to-handle sealing problem. Add that to a very limited space factor, and you've got a real set of conditions on your hands.

"John Crane" engineers have solved these problems and thousands of other shaft sealing applications on all types of commercial and industrial equipment. We know that we can be of the same help to you.

That's why . . . as one design engineer to another . . . we urge you to let us work with you in adapting or developing the proper seal for your application.

Tell us about your requirements or write for our fully illustrated Bulletin S-204-3 on "John Crane" Shaft Seals.

Crane Packing Co., Ltd., Box 134, Dept. AMS, Hamilton, Ontario.

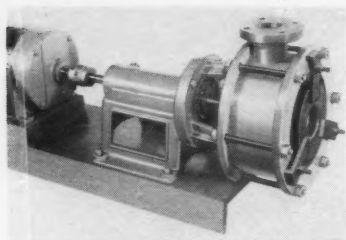


Circle number 112 on time saver card



## New products & materials

### Plastic Pump

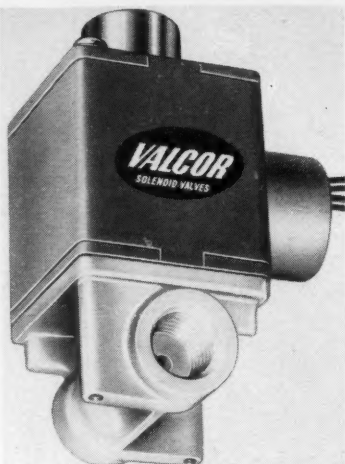


**Vanton Pump & Equipment Corp.**, announces their line of all-plastic PVC centrifugal pumps.

These pumps are constructed with all wetted parts of unplasticized, unmodified polyvinyl chloride, offering the broadest possible range of chemical resistance as well as the noncontaminating transfer of sensitive solutions. Available in four pump sizes, these units offer capacities from 10 to 180 gpm with discharge heads to 100 ft. Solution temperatures to 140 deg. F can be handled. (217)

### Nylon-body Solenoid Valve, SV-54 Series

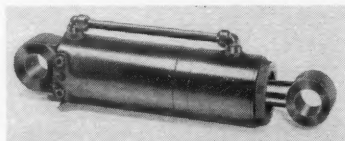
A solenoid valve that is said to outlast and outperform steel has been introduced



by **Valcor Engineering Corporation**. The SV-54 Series is recommended for general purpose and O.E.M. installations where millions of operating cycles are essential. (218)

### New 'Dual Pilot' Check Valve

**Benton Harbor Engineering Works** has designed a new double-acting cylinder around standard components.



The new cylinder features a "dual pilot" check valve which insures positive piston rod lock in any position when the directional control valve is in neutral. Incorporated in the cylinder head as a safety measure where drift is dangerous or undesirable, the design simplifies hydraulic line circuitry by eliminating separate pilot operated check valves, connections and lines. (219)

### Hydraulic check

A new, in-line single-acting hydraulic power check, designed to provide precise feed control of air cylinders has been produced by the **Appco Corporation**.

Known as the model 1500, it will check thrust loads up to 1500 lb. Applied to pneumatic cylinders, it is said to prevent chatter and flutter. Unit is



available in six sizes with strokes from two to twelve in. (220)

### Midget exhaust muffler

Eliminating irritating sounds caused by air powered devices is attributed to the new line of small air exhaust muffler made by **Mead Specialties**.

It has several distinctive features such

# Capital

## HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

**Capital Hydraulic Filter Units** are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

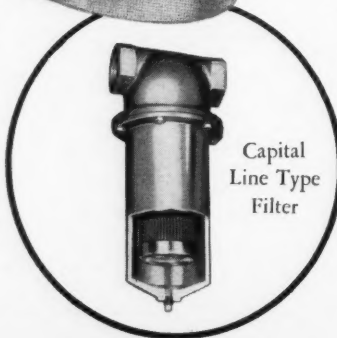
**Capital Filter Units** are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

**Capital Filter Units are made in 4 Types:**

- **MONO-BILT 60 Mesh All Stainless Steel (Sump type).**
- **MONO-BILT Standard All Stainless Steel**
- **MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.**
- **LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.**

Built from Monel Metal they are impervious to rust and corrosion.



Capital  
Line Type  
Filter

## CAPITAL ENGINEERING & MFG. CORP.

5831 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle number 153 on time saver card



## Briefs

(Continued from page 57)

a magnetic device the size of a pin promises to increase the "thinking" speed of future electronic computers 10 to 20 times and has been developed under the direction of D. A. Meier of National Cash Register Co.'s electronics division . . . . .

a big "sea sausage" oil tanker has been developed by National Research Development Corporation of London, Eng., it's 100 ft long, 5 ft in diameter made of woven nylon fabric and has a capacity of 10,000 gal. oil . . . . .

new test technique for anticorrosion properties of gear oils in cars with high-power engines and automatic transmissions has been developed by Co-ordinating Research Council Inc., according to Society of Automotive Engineers Journal (Dec. issue) . . . . .

Haloid Xerox of Canada has produced a compact device that automatically enlarges a 35mm microfilm frame to a positive, dry, 18x24 in. copy of an original engineering drawing in 30 seconds . . . brochure for 1958 Miniaturization Award is now available from Miniature Precision Bearings, Inc . . . . .

recent development work on the ADL Magnette Refrigerator has produced useful new practices in ultra-low temperature refrigeration, according to Vol. 1 No. 1 issue of Kelvin Scale published by Arthur D. Little Inc., . . . . .

at recent shareholders meeting Sir Roy H. Dobson, chairman of Board of Directors of A. V. Roe Canada Ltd. said "we are convinced that in all future aircraft there will be some element of vertical take-off—and that your companies have not been lagging in this new branch of aeronautical science." . . . . .

Honeywell Controls has designed a "dream" control centre for commercial and public buildings part of which enables the building engineer to "see" the temperature in his domain on a slide projection screen . . . . .

from Hewlett-Packard Co., Palo Alto, Calif., comes news of a new noise figure meter which automatically measures the noise figure of amplifier and microwave receiver systems . . . . .

the first autobody paint shop with infrared calrod elements was recently installed at the Auto Clinic Ltd., Toronto, by Canadian General Electric Company . . . . .

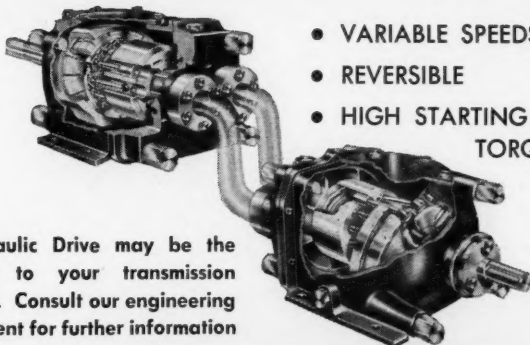
a new organization known as the Canadian Copper and Brass Development Association has been formed with offices in Toronto—see DE editorial on this subject for last month.

## INFINITELY VARIABLE

# V.S.G.

THE VICKERS-ARMSTRONGS

## HYDRAULIC TRANSMISSION



- VARIABLE SPEEDS
- REVERSIBLE
- HIGH STARTING TORQUE

A Hydraulic Drive may be the solution to your transmission problem. Consult our engineering department for further information

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## STRATOFLEX for your COMPLETE HYDRAULIC REQUIREMENTS



### HOSE and FITTINGS

Available in a wide range of types and sizes including TEFLON® for extremely high or low temperatures. Stratoflex leakproof, reusable fittings make possible quick, easy replacement or modification.

### HYDRAULIC COMPONENTS—SYSTEMS

**PUMPS:** Vane or gear types, ¼ – 100 GPM  
**MOTORS:** Vane or Gear types, 0.15 – 124 HP  
**VALVES:** Directional, Control, Relief, 2 – 150 GPM  
**POWER PACKS:** AC-DC to your requirements  
**CYLINDERS:** Double, Single, Telescopic action

Write for Complete Catalogs

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WHAT IS THE WORLD MADE OF?

## VIBRIN<sup>®</sup> of course!

At least, this one is, at the Museum of Science in Halifax. And it's only the most literal of thousand ways in which Vibrin is building a better world... improving on 'older' raw materials like wood and glass and metal... cutting costs... giving the light of day to new ideas.

Already VIBRIN is serving with success in boats, car bodies, aircraft parts, machine

housings, electrical accessories, fire-tower cupolas, translucent sheeting and innumerable other applications.

VIBRIN is a polyester resin reinforced with glass fibres. It is light, rot and rust-proof, and stronger than steel of equal weight.

In one way or another, VIBRIN is proving a 'find' to practically everyone who learns about it. And that information is yours for the asking. Simply write or call Naugatuck Chemicals at Elmira, Ont., or our branches in Montreal, Toronto, Winnipeg or Vancouver.

### other NAUGATUCK plastics

Vibramix - Polyester Resins • Marvinol - Vinyl Resins  
Kralastic - Styrene Copolymers



## Naugatuck Chemicals

DIVISION OF DOMINION RUBBER COMPANY LIMITED

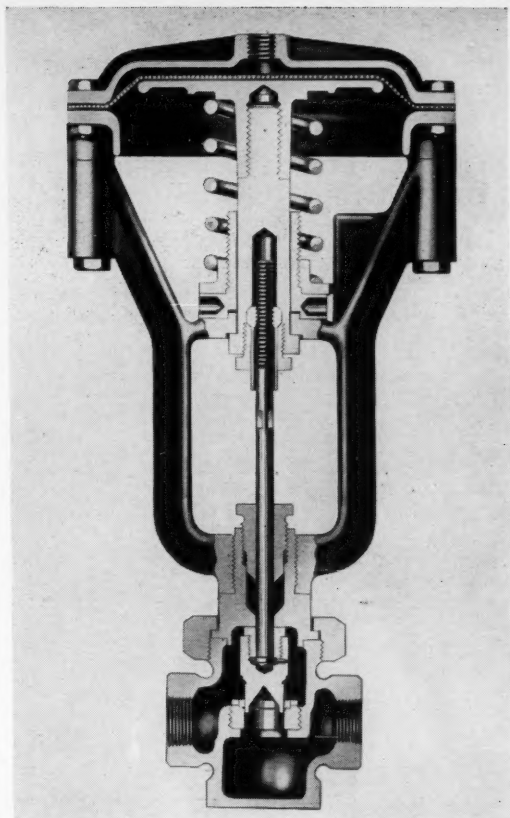
Circle number 150 on time saver card

## Diaphragm operated valve: an exclusive V-port design

A complete line of diaphragm operated valves designed for instrument-actuated control of temperature, pressure or flow, is announced by Sinclair-Collins Valve Company.

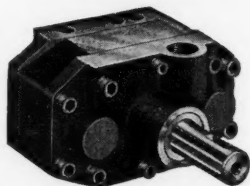
Featuring exclusive V-port design (said to afford extremely precise modulation of flow because of its tapered variable port area) these valves are offered in both direct and reverse acting types. Intended for steam, air, liquid or gas service up to 250 psi, diaphragm-operated valves are available in sizes ranging from 1/16 to 2 in. NPT (direct acting) and 1/8 to 2 in. NPT (reverse acting). Instrument air supply pressure requirements are from 2½ to 12 psi for the direct acting types; from 4 to 13 psi for reverse acting valves. Spring tension is adjustable.

Cast valve bodies are of Navy M bronze; yokes and tops are of high quality valve bronze. The corrosion-resistant K-monel stem and the 18-8 stainless steel spring assure trouble-free service. According to the manufacturer, the cast Stellite V-port disc and Stellite-faced K-monel seat eliminate wire drawing or cutting, even in the severest service. Stem packing is by chevron Teflon asbestos. (221)

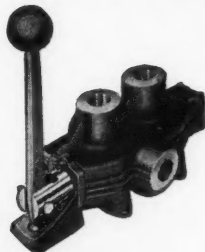


## HYDRAULICS — PUMPS, VALVES

GEAR AND VANE, PUMPS — CONTROL VALVES — RELIEF VALVES



**Gear Pumps**  
1000 P.S.I.  
8 and 12 G.P.M.  
Counter Clockwise—  
Max. 600 R.P.M.

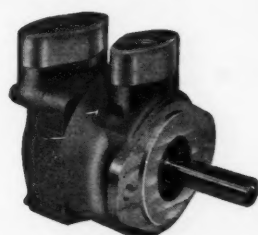


**Control Valves**  
3 Way (single acting)  
4 Way (double acting)  
1250 P.S.I.  
16 G.P.M.

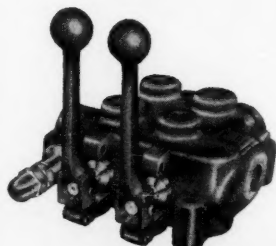


**Differential Relief Valve**  
7 G.P.M. at 15 ft./sec.  
24 G.P.M. at 15 ft./sec.

**Pressure Range**  
100 — 500 P.S.I.  
500 — 1250 P.S.I.  
1250 — 2500 P.S.I.



**Vane Pumps**  
**Specifications**  
1000 P.S.I.  
3-6-9-12-16-20-24 G.P.M.  
Max. 2000 R.P.M.  
**Rotation**  
Clockwise — Counter Clockwise  
Mounting Feet Available



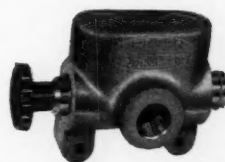
**Control Valves**  
1-2-3-Spool  
Built-In Adjustable Relief Valve  
Reversible Handles  
Open Center — Closed Center  
Free Flow — Float Valves  
Available with Top, Bottom or  
Side Outlet. Also with Two Part  
Outlet for power beyond.

**SPECIFICATIONS**  
1500 P.S.I. — 40 G.P.M.  
For Parallel Application

Write for Catalog

**OTHER GRESIN  
PRODUCTS**

Float Position  
Valve  
Couplings



**Selector Valve**  
Openings — ½" NPT  
Openings — ¾" NPT  
Openings — 1" NPT

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405-35TH AVENUE N.E.

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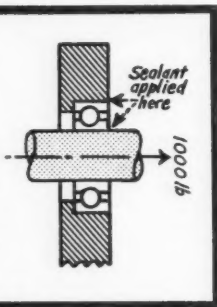
Circle number 154 on time saver card

Edwin F. Oblinger, Chief Engineer,  
Parker Sweeper Company, says:

## "WE THREW OUT PRESS FITS FOR BEARINGS..."

"We used interference fits to prevent bearing races from turning in the gear box of our 4HP Turbo-sweeper. Maintaining close tolerances was a constant headache. If the fit was loose, the race would slip and fret the surfaces; if the fit was tight, the race would deform and bearing life would be shortened. Then we discovered LOCTITE Liquid Sealant would do away with the need for press fits. We opened up the tolerances for both shaft and housing and used a slip fit, filling the clearance with LOCTITE. The bearings are retained with a force equal to the customary interference fit, but we've reduced rejected parts from 8% to less than 1% and reworked parts fell from 20% to 0! Field reports are excellent."

**LIQUID SEALANT**  
... replaced interference fits and opened up tolerances almost 0.002 in. on shaft and housing for this ball bearing assembly. Load of over 1000 lbs. is needed to break bond.



LOCTITE is a penetrating liquid that hardens only after being confined between closely fitted metal parts. In the absence of air, the sealant hardens into a strong, heat and oil-resistant bond. The hardening action may be accelerated by heating.

LOCTITE eliminates the need for interference fits on bearings, sleeves, shafts and studs... locks nuts to bolts, seals pipe and tubing joints.

For literature and free sample write to:

**LOCTITE<sup>®</sup> SEALANT**

**AMERICAN SEALANTS COMPANY**

601 Woodbine St., Hartford 6, Conn.

**J. S. PARKES CO., LTD.**

220 St. Paul Street, West Montreal, P.Q.

Circle number 102 on time saver card



## Keeping informed

### New booklets and technical data for you to read

**Piston type relief valves** — four new catalogue sheets have been announced by Fluid Controls Inc. They contain full dimensional information.

**Breather filters** — particularly a line of 40-micron type for free flow of clean air into hydraulic fluid, fuel and oil reservoirs is now available from Bendix Filter Division, Bendix Aviation Corporation.

**Flow-control servo valves** — catalogue 220 just published by Moog Valve Co. Inc. gives full details of the firm's line of equipment for aircraft, nuclear, missile and industrial applications.

**Centrifugal pumps** — if you're interested in single-stage side-suction type with open impeller, Goulds Pumps Inc., have just put out bulletin 720.4 telling all about their wide variety of application.

**Hydraulic tube fittings** — a 28-page catalogue produced by Flodar Corporation fully describes in three, easy-to-use sections their self-flare, no-flare and flare-type fittings.

**Fibre cartridge filters** — the depth-type for full flow filtration of all types of fluids are presented in new Micro-Klean catalogue by Cuno Engineering Corporation.

**Proportioning pumps** — American Meter Company's pump division has published a new technical bulletin describing their series 100 pumps.

**Friction tester** — the new A-6 friction and wear tester is described and illustrated in a bulletin published by the Hohman Plating and Manufacturing Co.

**Air-hydraulic cylinders** — full specifications on the Alkon Products Corporation model "D" cylinders in their new brochure.

**Flexibox seals** — bulletin No. 10 gives comprehensive information for engineers needing more information on flexibox seals for the process industries. Illustrated throughout 12 pages, and published by Sealol Corporation.

**Missile and rock valves** — a wealth of information on 48 different solenoid valves. Dimensional drawings, flow charts and production test data. Sky-valve Inc.

**High-velocity panel filters** — a handy bulletin B-100-2B describes the high velocity impingement filter developed by the Farr Company.

**Hydraulic tube and pipe fittings** — Flodar Corporation has published a four-page illustrated folder describing their new line of straight-threaded fittings.

**Miniature pneumatic devices** — profusely illustrated brochure tells the story of Clippard Instrument Laboratory's "push-button aids to automation."

**Control valves** — full information on the Conoflow Corporation's products described in Series LB booklet.

**Gas damped accelerometers** — this type of measuring device is outlined for you in a bulletin by Statham Instruments.

**Process instruments** — 51-page Fischer and Porter Company catalogue gives information and prices on indicators, transmitters and other types of controllers.

**Ductile vanadium** — a new engineering material. This is title of a new brochure published by Vanadium Corporation of America.

### American Society for Metals meeting

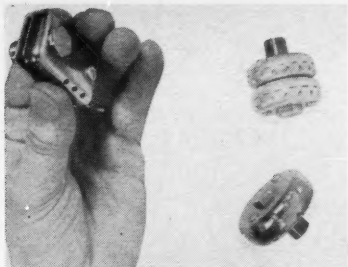
American Society for Metals Meeting—An interesting film show preceded the lecture by John B. Burk of Atlas Steels Limited on "Trends in Stainless Steel" at the last meeting of this Society. Called "Supersonic Sentinel," the film gave development details of the Avro Arrow. Included were such items as:

The electronically controlled skin-mill for machining the wing skin-stiffeners; flight test spinning models; testing the Iroquois on the B.17; wooden mock-up for checking windshield design; rigs for testing the fuel system, the flying controls and the air-conditioning and electrical systems; the Martin-Baker ejection seat; the 1/4 scale models for checking drag and stability (attached to a Nike rocket booster); the kine-theodolite cameras and radar used to collect flight data. In all, a very good evening.



## New products

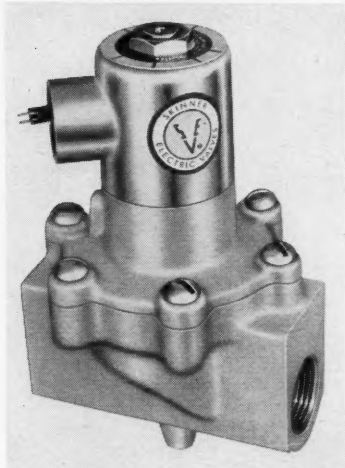
continued



as anodized aluminum construction, truly miniature proportions and it utilizes long-lasting polyether foam as the silencing medium. Three models are obtainable. (223)

### L Series Valves

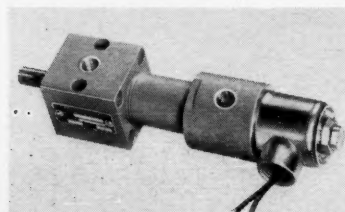
A new series of high-flow, two-way valves with  $\frac{3}{4}$  in. and 1 in. diameter orifices are announced by Skinner Electric Valve Division.



These L Series valves complete an all new line of two-way valves previously introduced in January in  $\frac{3}{4}$  in. and  $\frac{1}{2}$  in. sizes. They are designed to control such common media as air, oil and water and are smaller, more compact and considerably lower in cost than the M2 Series valves they replace. (224)

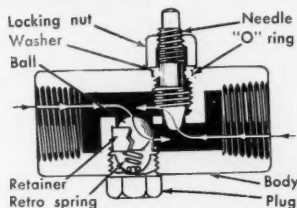
### Valve-operated Cylinders

Airmatic Valve, Inc., has a new line of valve operated cylinders. These combine a conventional single-acting cylinder with the new Airmatic 33800 series, three-way solenoid valve.



These units can be used as fixture clamps or with jigs, fixtures, knockouts and release mechanisms in a wide range of industrial applications in industries such as electronics, plastics, petroleum, beverage, metalworking, woodworking and machine tools. (225)

### Flow Control Valve



This valve combines in one compact body design (say makers), two types of valve—a floating retro-ball check which provides full flow in one direction: a tapered, fine thread needle which gives a wide range of adjustment of the flow in the opposite or controlled direction.

Pneu-Trol Devices Inc., claim that the sensitivity of the floating, retro-ball and fine adjustment of the needle, make possible many control applications considered impracticable by other means. Valves are made in five female pipe sizes  $\frac{1}{8}$ -in. to  $\frac{3}{4}$ -in. (226)

### Portable Pneumatic Calibrator

The Wallace & Tiernan series A-755 precision pneumatic calibrator is an ac-

# BOSTON GEARS

SPUR GEARS  
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PINION WIRE and RACK  
REDUCTORS and RATIOMOTORS

Call **RENOLD** also for chain drives, conveyor chains, chain tools, wheels and attachments, couplings and clutches.

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## New products

Continued

curate, portable instrument primarily designed for field checking of pneumatic controls and instrumentation, particularly transmitters, recorders, and controllers in place (on stream), in the 3 to 15 psi range. A precision dial manometer is secured to a shock mounted panel in a portable carrying case. (227)

### Low Cost Control Valve

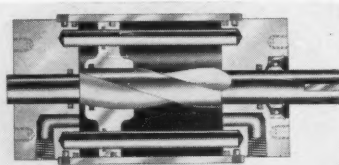
A low cost flow control valve, said to permit unusually precise control of air, gas or low pressure hydraulic flow

with unrestricted return, is announced by **Valvair Corporation**.

Known as the Valvair Micro-Trol, the new valve features locked screw adjustment and a combination of controlling elements, a threaded stem and molded nylon flapper. (228)

### Rotary Actuator

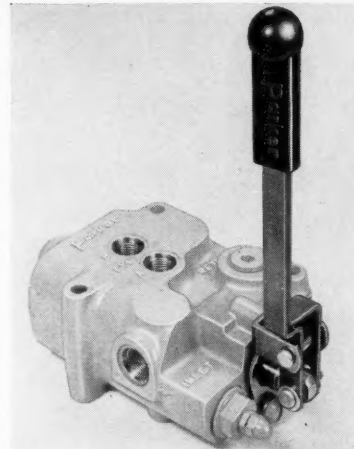
The **Carter Controls, Inc.**, rotary



actuator is a self-contained power unit designed to operate on air, gas, water or oil pressure. It delivers a fast and positive rotary motion by means of a piston and central internal helix. An almost unlimited number of motion applications are possible with the new actuator. (229)

### Control Valves with Handles

A new line of one-spool hydraulic directional control valves with handles, for general-purpose applications, is announced by **Parker**. Three capacities are offered, with nominal ratings of 12, 20 and 40 gallons per minute. Maximum working pressure recommended is 2,000 psi.



(230)

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### New Needle Valve

**Dragon Engineering**, manufacturers of precision needle valves, has announced the introduction of their new, high pressure, liquid oxygen (L.O.X.) needle valve, model 808.

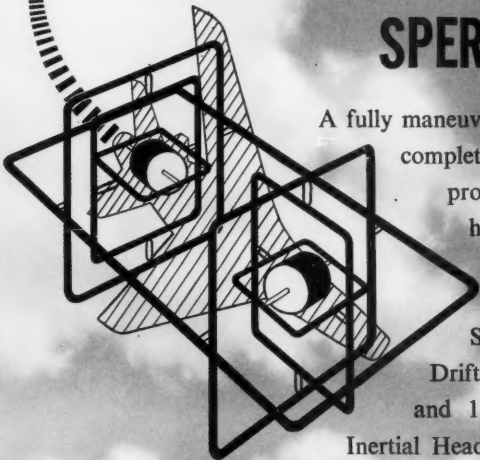
Designed to be forged from 316 stainless steel for a size range from 1/8 to 1 in., model 808 operates at very low temperatures of -300 deg. F and at pressures up to 10,000 psi. This valve has been engineered with resilient Teflon or KEL-F packing and has a design "burst" pressure of 30,000 psi. (231)





Unprecedented accuracies are demanded...

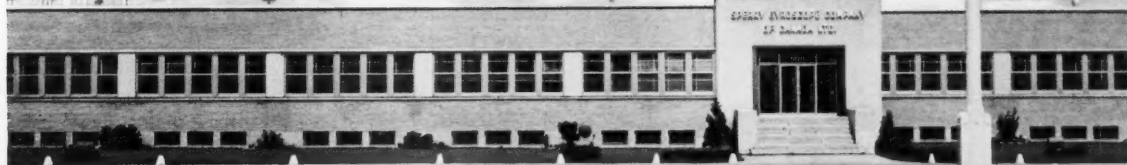
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A fully maneuverable twin gyro platform, utilizing completely new gyro design principles and providing unprecedented accuracies in heading information and all-attitude flight, will soon be ready for flight trials. Features of the Sperry Stable Platform are:— Low Random Drift (as low as  $\frac{1}{4}^\circ$  per hour in azimuth and  $1/10^\circ$  per minute in the vertical);

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*Sperry engineers are continually striving to aid the advance of aviation through the creation of better systems and equipment.*

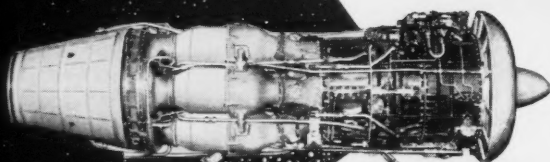


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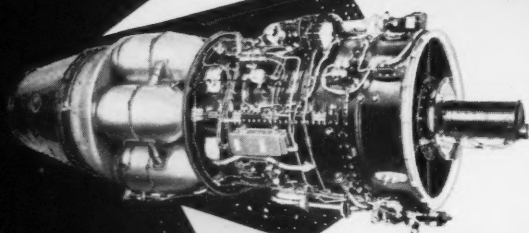


**MORE POWER** *by*



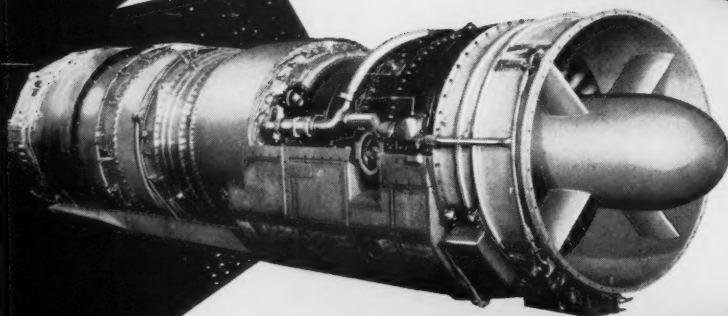
#### **CHINOOK**

Canada's first gas turbine engine was initially run on March 17, 1948 at 2600 lbs. thrust. Thrust-weight ratio developed to 2:1.



#### **ORENDA**

First run on February 10, 1949. More than one million hours of operational service to date in CF-100's and Sabres of the RCAF, West German, Belgian, South African, and Colombian air forces. Thrust-weight ratio, 3:1.



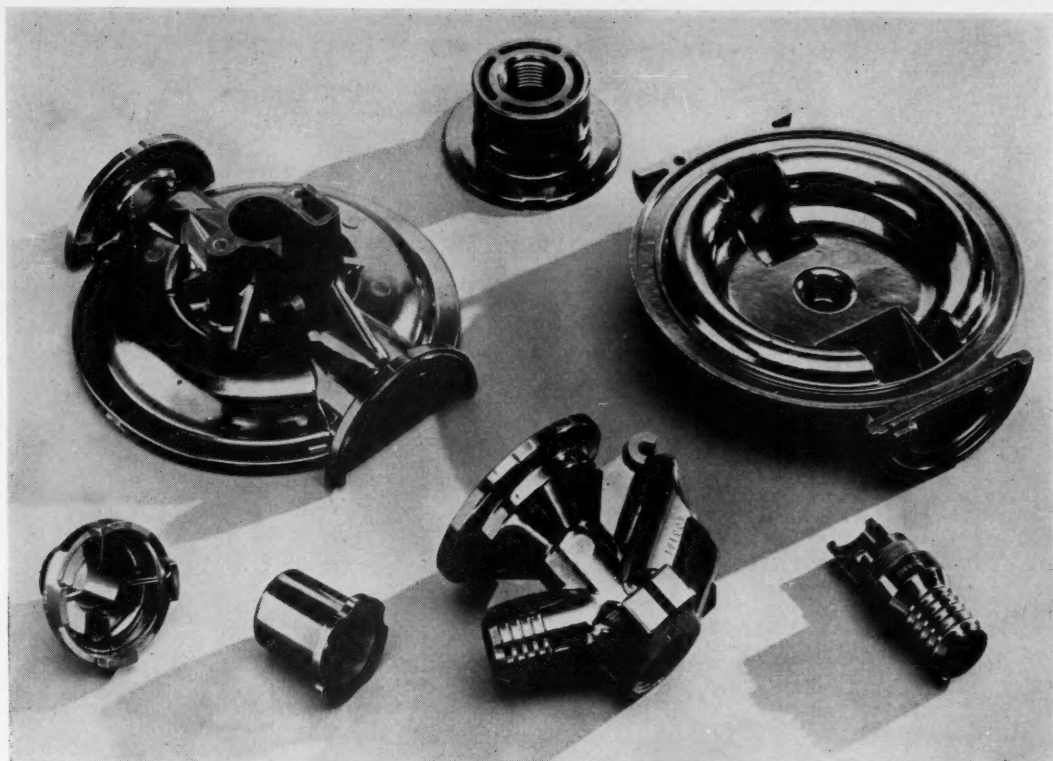
#### **IROQUOIS**

First run December 15, 1954. First production Iroquois are for the AVRO ARROW Mark II. Thrust-weight ratio, 5:1 DRY

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*Photograph shows the housing and other parts of the hand pump made of corrosion and chemical resistant Durez.*

## Hand pumps made by precision molding

Precision molding is vital to prevent mismatching or warping of these seven Tokheim Corporation pump parts, molded (of Durez phenolic plastic) on six molds. The phenolic used in this plastic version of a larger model (made of diecast metal parts) eliminates many of the finishing and assembling operations of that version.

The parts are held together by a cadmium-plated, snap-on clamp (which prevents leakage) and cover sections must be air-tight and liquid-tight for efficient operation under minimum vacuum of 20 lb.

Wayne Plastics Corp. (who molded the pump parts for Tokheim) made their own mold for one part and had the other five molds made by three different companies. The firms met in a close deadline, and all the molds worked perfectly upon delivery. The parts are plunger-molded, with cam-operated cores operated by hydraulic cylinders.

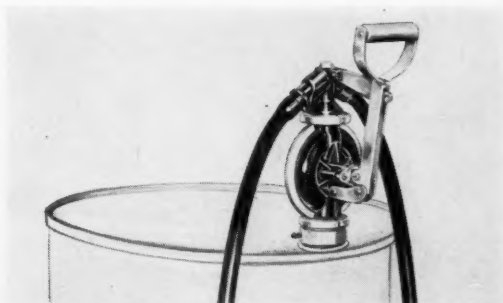
The dimensional stability and flexural strength of the Durez phenolic were found ample to meet the exacting tolerance requirements of this application, even in one of the parts which had extremely fine threads.

Corrosion (and chemical) resistant, the phenolic is especially suitable for pump and valve parts where the sections are wet on the inside but dry on the outside. In addition, the product is non-static, thus eliminating the danger of sparking in the handling of volatile liquids, as for example when the pump is used to empty drums filled with gasoline.

The pump (which operates on both forward and

back strokes) is designed for dispensing petroleum products at a rate of 12 gpm. Self-venting bung adapter and flexible synthetic suction hose make installation a simple operation.

Two pump models are available. Model 476-7 (with hose and nozzle) is equally suitable for drum or skid-tank installation, and lends itself particularly to farm use. Model 476-15 (container filler with spout) is ideal for transferring liquid petroleum to pails, which may be hung securely from the spout hook. Safety and efficiency are provided by both models, for spillage, waste, accident and fire hazards are kept to a minimum. ★



*The pump being non-static can handle volatile liquids*

## Automation: this treatment of impression stroke worked wonders with machine and operator efficiency

Determined to reduce the elbow-grease required in the operation of their Addressograph 600, the J. B. Morrison Machinery Co. Ltd. decided to automate the machine's impression stroke.

Using Dexion slotted angle as a frame, they added the following pieces of equipment:

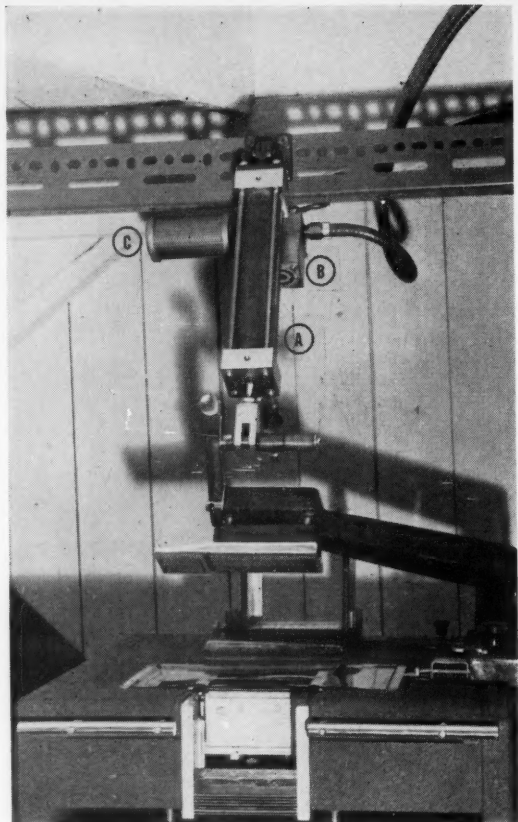
- (A) Alkon Products Corp. air cylinder 12-6
- (B) Valcor solenoid valve (SV-1000-3)
- (C) Allied Witan Co. MO2 Atomuffler

Also added were a Mead No. 1 quick exhaust valve and a Minneapolis-Honeywell L28 foot Micro Switch (not visible in the photograph).

Results from this rig have been excellent. Among the advantages that it offers are:

- No tiring of the operator, even after long runs.
- Both hands are available to feed the envelopes.
- No falling off in the weight of the impression.
- Faster operation.

(232)



## Cushions: these cylinder types are floating and self-centring

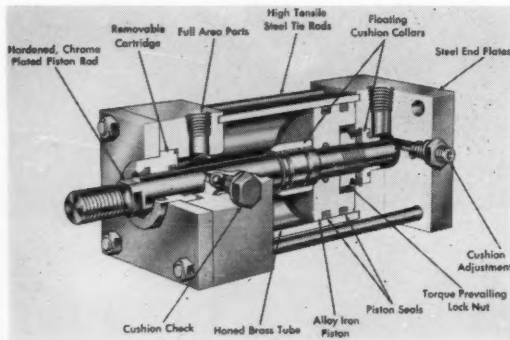
The S-P Manufacturing Corporation announces the use of floating, self-centring cushions in their standard duty line of air and hydraulic cylinders.

Designated Series A, these cylinders are said to be interchangeable for use with air, oil or water, at pressures up to 200 psi (air) and 500 psi (oil or water). The cylinders have floating metallic cushions, to afford uniform cushioning throughout the life of the cylinder

and to prevent cushion wear. Cushioning is fully adjustable.

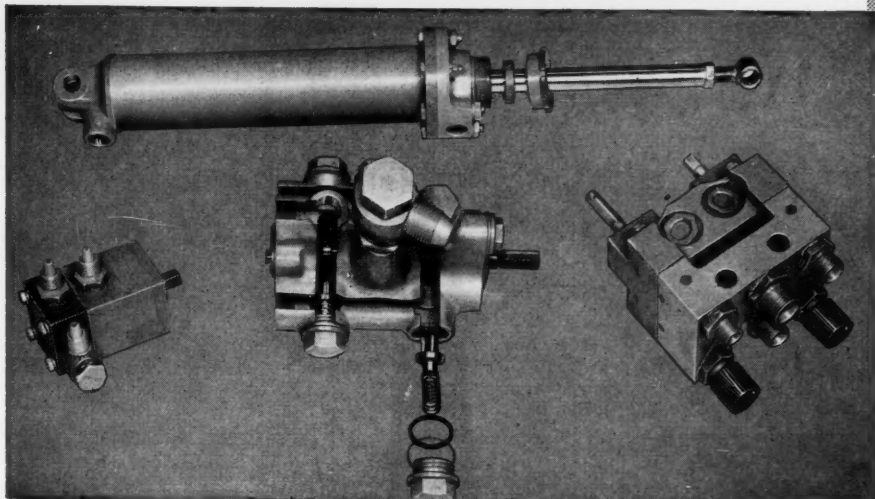
The cylinders are built to automotive manufacturing and JIC standards. Claimed to be ideal for all types of industrial application, they are offered in 21 models, with a full choice of basic mounting styles: foot, flange, clevis and trunnion. Bore sizes range from 1½ in. to 14 in., with strokes to specification. All models are available non-cushioned, cushioned rod or blank end, or cushioned both ends. Cushioned and non-cushioned cylinders have identical mounting dimensions. Both cushion check and cushion adjustment are interchangeable without cylinder modification.

Design and construction features of the Series A cylinders assure excellent performance and long trouble-free service life, it is claimed. Honed hi-tensile brass barrels, hard-chrome-plated piston rods and rust-proofing of all ferrous parts afford maximum resistance to corrosion. The heat-treated piston rods are offered in a choice of sizes. A radius at the end of the rod thread is to prevent stress concentration. Large ports, available in alternate positions, assure fast cylinder operation. Optional rod ends, extended tie rods, rod eyes, mounting brackets are offered too. (233)



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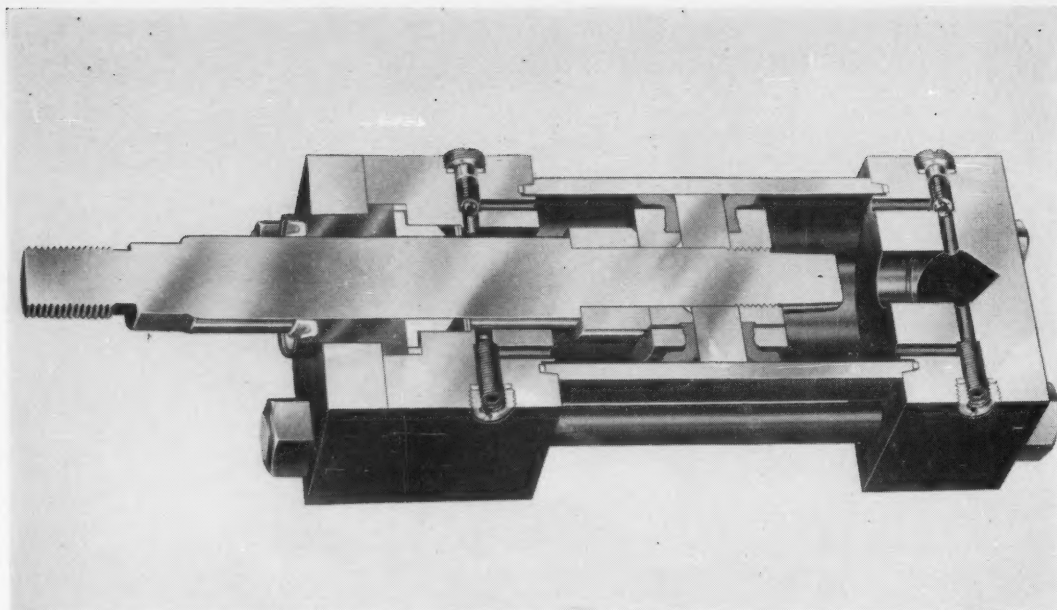
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Cylinder fitted with cup seals. For clear recognition, same cylinder type was used to point up differences.

## A case of piston rings vs cup seals

**Here's a terse treatment on some of the best features of each. Cup seals keep out foreign bodies . . . but piston rings can withstand lots of heat**

The question frequently crops up as to where cup seals should be used in preference to piston rings, and vice-versa.

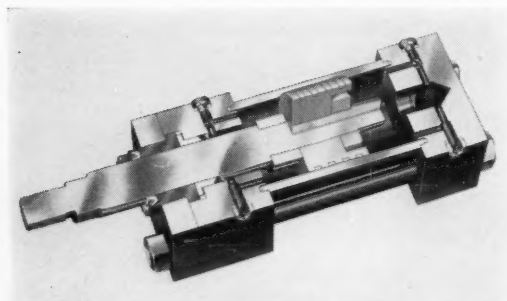
The Miller Fluid Power Division, Flick Reedy Corporation, considers that because cup leathers have a distinct advantage over piston ring construction there is more tendency for a piston ring to score if there is dirt in the system. The reason is that (with piston ring construction) there is a clearance between the piston and cylinder barrel which allows the entry of fine particles of dirt that cannot get past the piston ring. As the piston moves back and forth in the cylinder barrel,

it also tends to move from side to side, depending on the alignment with the attached machinery. Thus, after dirt has entered a clearance point on one portion of the stroke, this clearance can be completely taken up by the shifting of the piston, and some material squeezes between the piston and cylinder barrel and causes scoring.

With cup construction, the cup itself wipes this dirt from the cylinder barrel and, in general, does not let it get into any parts that have metal-to-metal contact. Scoring trouble of this kind is usually experienced in starting up the machine, because of the small amount of dirt that it is almost impossible to eliminate while the machine is being piped up. After all the oil has passed through the system and flushed these dirt particles out, they will be prevented from entering the system due to the suction filter in the line. Thus, if scoring does not occur while the machine is being put in operation, there is little danger of it ever occurring.

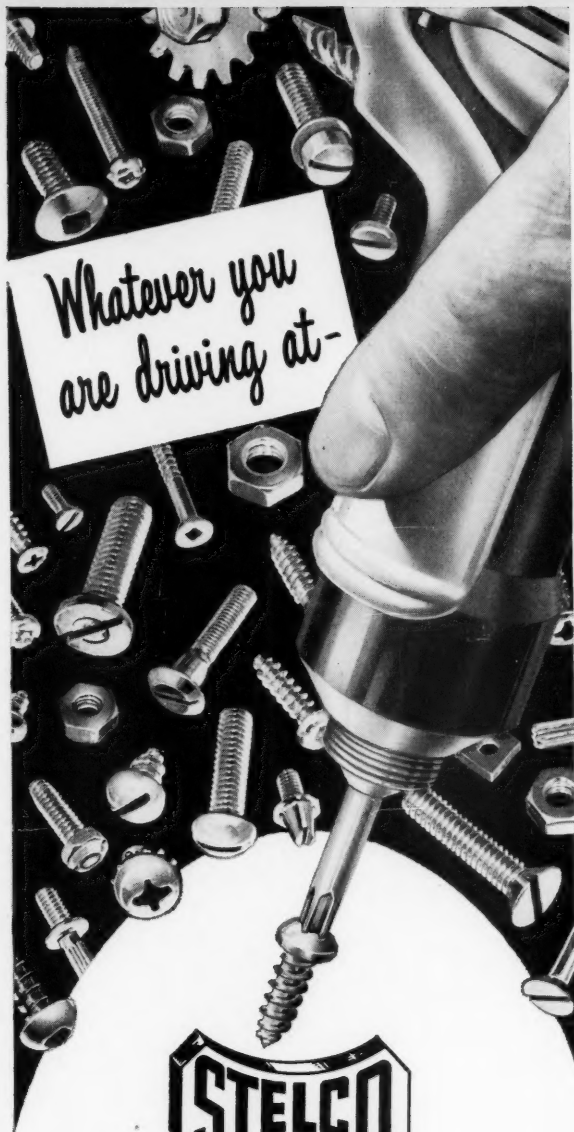
Piston rings are definitely recommended where high temperatures are encountered, due either to inherent heat being produced in the pumping system or due to external process heat being reflected or conducted into the cylinder or hydraulic system.

Miller hydraulic cup type seals operate best at temperatures below 130 F, but will function properly up to 150 F. The proper use of heat shields in most cases materially reduces the operating temperature of seals. For cylinders that must operate at higher temperatures, further and specialized advice should be sought. ★



The cutaway model indicates that it has piston rings.





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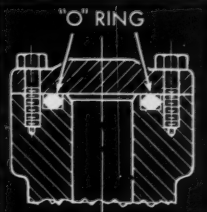
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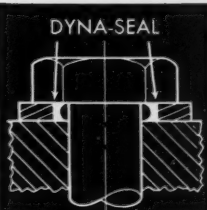
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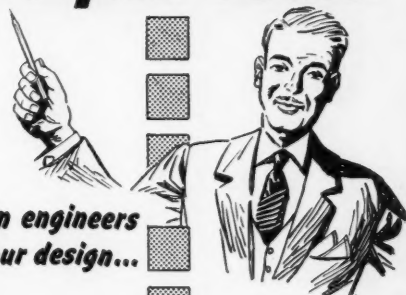


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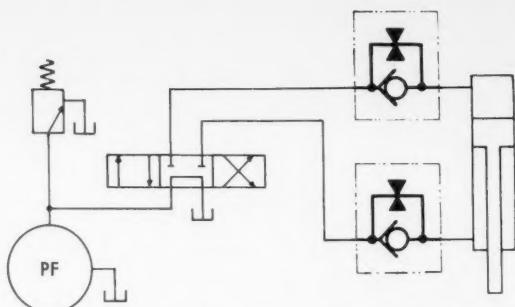
TORONTO 18, ONTARIO

Circle number 132 on time saver card

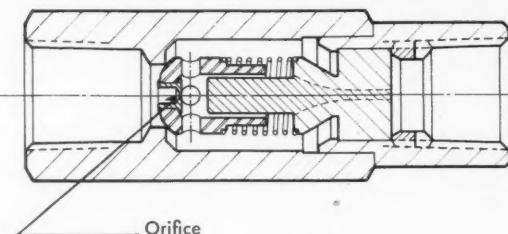
## Restrictor valve: it has retention cap for safety

Fluid Controls, Inc. (manufacturers of hydraulic valves and devices) have announced a restrictor valve which features a safety retention cap designed to prevent complete removal of the needle and blow-out of the stem. The retention cap is an important safety feature, for it eliminates the danger of the stem blowing out and injuring personnel, yet it in no way affects the convenience of the flow adjustment.

The restrictor valve (which is designed for free flow in one direction, and restricted flow in the opposite direction) also permits substantially increased flow capacity in the restricted flow direction and allows a wider range of flow adjustments. (234)



Restrictor valves are used to regulate the speed of a cylinder in one direction. When speeds in both directions must be regulated two restrictor valves are used. It is generally better to regulate flow from the cylinder, rather than to the cylinder.



## Hydraulic cylinder: with pressure-tightening tube seal

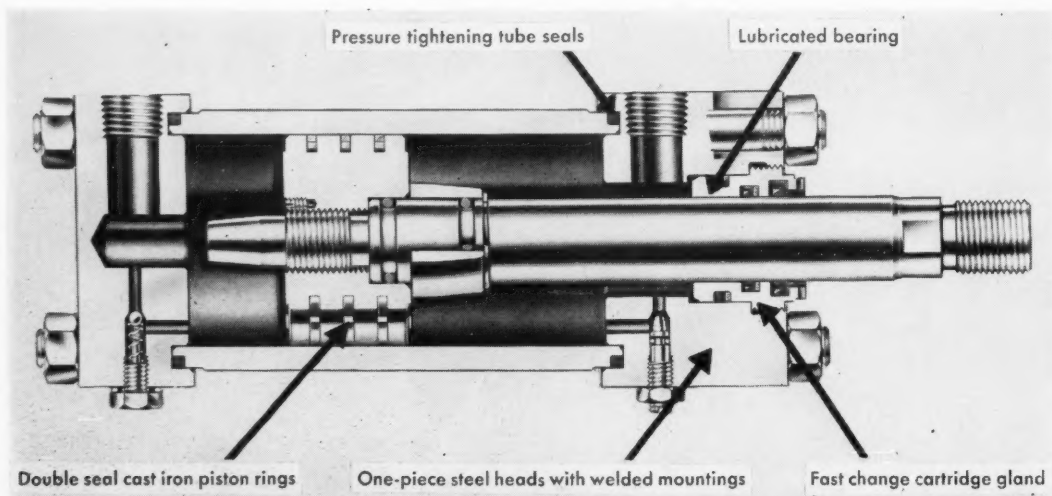
The new Powdraulic hydraulic cylinder line (introduced by Hanna Engineering Works) features a pressure-tightening tube seal. This O ring seal is located on the outside diameter of the tube and is fully confined between the tube and cylinder head. Because the seal is on the tube OD, minute expansion of the tube under pressure squeezes the O ring and increases the tightness of the seal. Unlike tubes that seal at the ends or on the ID, this seal remains tight at all pressures.

The cylinders are rated at 2000 to 3000 psi non-shock, with a generous safety margin. Bore sizes range from 1½ to 8 in. Thirteen basic models and a choice of rod sizes permits the selection of a standard cylinder

for practically every application. The cylinders have standard mounting dimensions and conform to J I C recommendations.

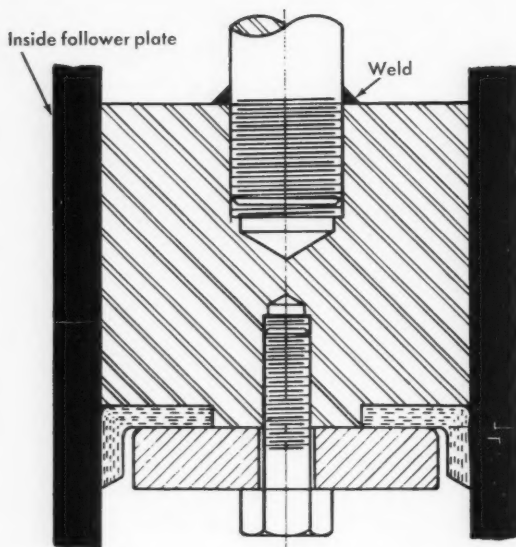
One-piece, solid steel heads with welded mountings give added strength to the cylinders. Since all mountings are welded, accurate alignment and squareness of mounting are assured.

Other standard features are: the double-seal piston rings and a fast-change cartridge gland that has an automatically lubricated bearing. The cast-iron piston rings are bi-directional seals and have the sealing power of six conventional piston rings. An optional piston (with U packings of synthetic rubber) is also available. (235)





## Cup packings: easy installation and wide application



Design simplicity and ease of installation have given cup-type packings a wide use in industry. E. F. Houghton & Co. produces Vix-Syn fabricated cups in the broad range of sizes necessary to meet these varied industrial demands and the latest JIC standards.

The cups are molded of cotton duck, fricitioned with synthetic rubber. This construction (the result of their long experience in the design and application of fabricated (and homogeneous) packings) makes them ideal for use on heavy duty equipment, where common metal finishes and greater machine clearances are found.

These cups function efficiently under acidic or alkaline conditions. They seal in temperatures from 0 to 250 F and under pressures up to 10,000 psi.

A cup packing is usually bolted to the end of a piston or plunger. Several methods of installation are in use, including the use of a boss, as shown. The boss centres the cup on the piston and prevents over-tightening. Undue compression of the bottom of the cup by mechanical means causes the shoulder to bind against the cylinder wall, creating unnecessary friction which shortens packing life.

This single acting installation shows the piston rod screwed into a piston and welded. Welding is not necessary if some other means is used to prevent the piston from becoming unscrewed from the rod. (236)

## Bar stock valve:

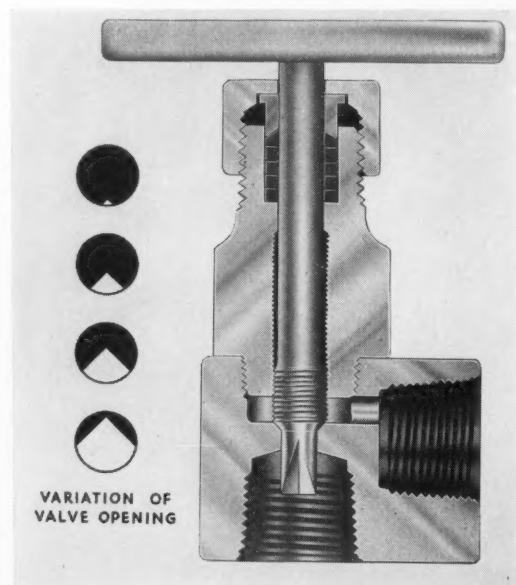
### it reduces clogging problems

A completely new type of bar stock valve is being manufactured in all standard sizes to 1 in. by the General-American Valve Co. This valve uses the Veegroo tapered orifice principle, designed to eliminate clogging problems. Pressure ratings for the valve are 3,000 and 10,000 psi. Materials available are carbon steel, 303, 316 or 416 stainless steel, alloy 20, monel and aluminum.

The valve offers a radically new concept of flow control. By moving a plug with a tapered slot in or out of a circular opening, the flow of fluid or gas is controlled by the area of the slot at the head of the opening.

It will replace the needle valve for nearly all applications, and will pass foreign particles twenty-five times as large as will comparable needle valves.

The valve is available in the bar stock type, cast bronze, large iron body, and large high pressure steel body, as well as custom designs. (237)



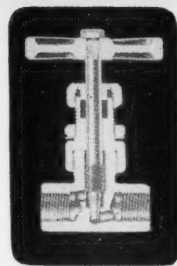




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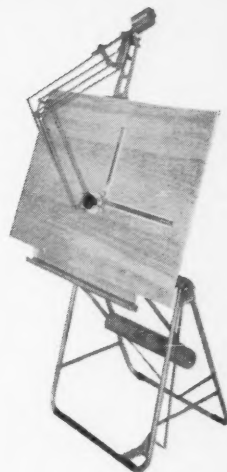
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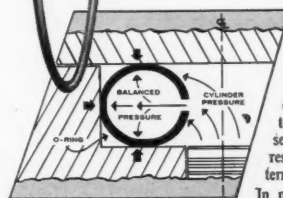
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ringside view of United's  
exclusive feature for

### Pressure Tight Seals



United's exclusive, patented\* self-energized metallic O-rings are circular tubes vented by tiny holes drilled in the ring wall. The holes are to balance the interior and exterior pressures in order that the ring may respond to variation in deflection of the sealing surfaces with a natural resilience uninhibited by the external pressure.

In metal-to-metal applications, self-energized metallic O-rings are capable of forming positive, permanent, non-corrosive static seals under extreme temperatures from -321°F to 1800°F., and under pressures equal to ultimate compression stress of the metal itself. Available in various metals and finishes,  $\frac{3}{16}$ " dia. to any size or configuration. United also makes non-vented and pressure-filled O-rings; and wire and brazing O-rings. Write for free 22-page booklet (on your letterhead please).

PATENTS 2,809,269; \*2,837,360

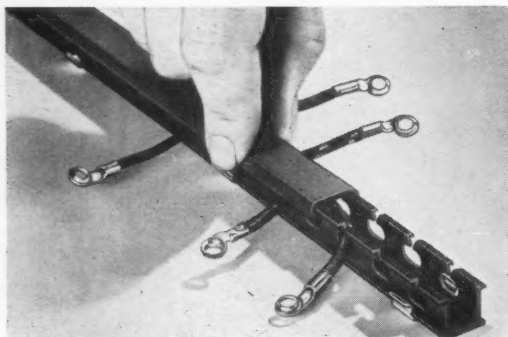


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## Wiring duct: miniature design is fireproof, time and space saver

A miniature wiring duct (developed by Panduit Corp.) provides an ideal wireway for electronic installations. It is available in a complete range of small cross-sections, all featuring an exclusive snap-in slot design that allows the wire to be laid after the terminals have been attached.



The duct slots are separated by individual plastic fingers, which flex enough to allow the wire to be inserted in the slots, but which snap back into place immediately after insertion. The time-consuming operations of lacing, bundling and threading small wires through duct holes is completely eliminated. The duct cover also snaps into place, further reducing wiring time and allowing quick access for inspection or revision.

Made of tough, nonflammable vinyl plastic, the wiring duct is a compact raceway for use in communications equipment, computers, mobile or airborne components control panel assemblies and many other electronic installations, where space is at a premium.

For standard mounting, an ordinary screw may be used through a hole drilled in the base. Mountings require no special tools. The duct is easily cut with a fine-tooth hand or power saw. Corners can be mitered. No fittings are required.

For fast, easy mounting, the company supplies a snap-type spring steel clip. No mounting holes are required and there is no metal inside the ducts. Wires may be sub-assembled into the duct and the whole unit snapped into place, ready for connections to be made. (238)

## Bearings: new Rulon formulation used in dry bearing development

S-Liner bearings are the latest development by the Dixon Corporation in the nonlubricated bearing field. They will extend the range of loads and speeds at which bearings can operate without any lubrication. Bearings made of this new material have been run continuously without lubrication for over 1,000 hr at PV values of 20,000 and in intermittent operation at PV values of 40,000.

The construction is the result of many years of development work in an attempt to take full advantage of the properties of Teflon. Its low coefficient of friction (0.04 to 0.2 against steel) has always made it interesting as a potential "dry" bearing material. Unfortunately, its poor wear resistance, its tendency to "cold flow" under load, and its combination of low thermal conductivity and high coefficient of expansion have limited its usefulness in the bearing field to very low speeds and loads.

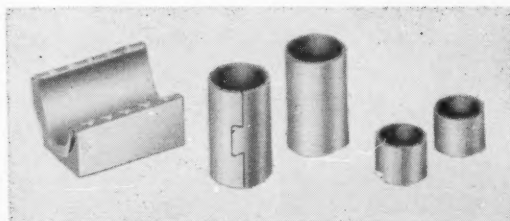
In order to break through to considerably higher PV values, an entirely new type of bearing material has been developed.

The S-Liner construction consists of a steel-backed woven wiremesh supporting matrix impregnated with a new formulation of Rulon and given a special surface treatment. While many variations are possible, the present standard bearing consists of a 60 x 60 mesh woven phosphor-bronze screen bonded to a plated steel backing, with a special formulation locked into the in-

terstices of the wire and covering the wire surface. This new construction makes it possible to run bearings at high loads and speeds, because the thinness of the layer (and the presence of the wiremesh) provides good heat dissipation. The "cold flow" is also practically eliminated by this construction.

Parts shown are:—

- (A) Roll stand bearing for textile spinning frames. The metal back is die cast to the slip-liner, which is flexible and flanged at each end to carry end thrust.
- (B) Rolled bushings with locked joint. These parts made for household equipment were held to a runout of .001 in.
- (C) ½ in. x ½ in. standard rolled bushings without locked joint. (239)



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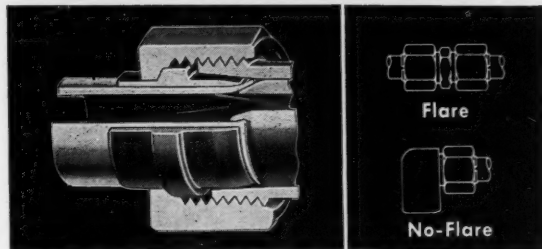
### PNEUMATIC & HYDRAULIC CO. LTD.

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MONTREAL, P.Q.

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## NOW! Get the advantages of both FLARE and NO-FLARE fittings with



### FLODAR'S

#### Combination Self-Flare Tube Fittings

**The Easy Installation Of A No-Flare Fitting** — no time consuming flaring operation — no flaring tools required. Can be used with heavy-wall tubing and, provides a seal on the OD of the tube.

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- Easy Assembly — "Rock Bottom" stop signals that joint is sealed.
- Double Seal — seals on both OD and ID of the tube.
- Lower Cost — FLODAR'S Self-Flare fittings cost less to buy and install.

You gain the advantages of both flare and no-flare fittings with none of the disadvantages . . . when you switch to FLODAR Self-Flare tube fittings.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

Priced competitively, this fitting is available in tube sizes from 1/8" to 2" and in steel, stainless, brass and aluminum.

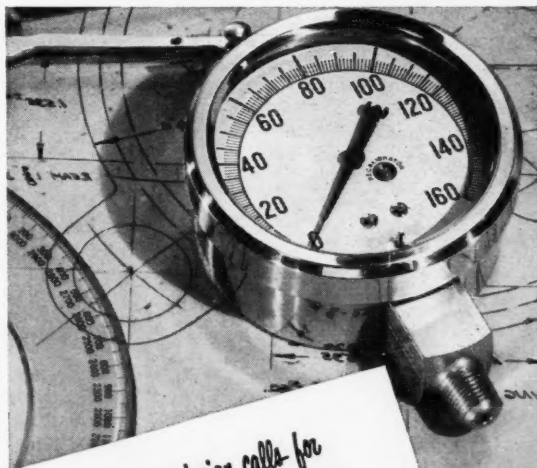
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## F FLODAR Corp.

16911 ST. CLAIR AVENUE • CLEVELAND 10, OHIO

Canadian Distributors—ARVIS ENGINEERING, LTD., 1105 Royal Avenue, New Westminster, British Columbia, Canada • MARSHALL EQUIPMENT CO., INC., 61 O'Connell Ave., Dorval, Quebec, Canada • NORTHERN HYDRAULIC SERVICE, LTD., 5710 - 103A St., Edmonton, Alberta, Canada.

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Marsh Instrument & Valve Co. (Canada) Ltd.  
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3501 Howard Street, Skokie, Ill.

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## Editorial

### Let's shop-window Canadian design

Several times we have commented editorially on the sad lack of interest shown by Canadians in the Design Engineering Show, held each year in the States.

Our comments have now had effect, for this year the Canadian Government has booked 980 sq. ft. at the Show (to be held in the Convention Hall, Philadelphia, May 25-28) so that 15 or 20 selected Canadian engineering companies can shop-window the designs they have available for export.

Generally, the Department of Trade and Commerce pays the expenses of participation in an exhibit. The cost of space, of building the display, of shipping, erecting, dismantling and returning it to Canada, are borne by the Canadian Government Exhibition Commission. The exhibiting firm, is, of course, responsible for supplying products for the display, for shipping them to Ottawa before the Show (and from Ottawa after) and for insuring the goods against loss or damage.

At the time of writing, the exhibitors have not been chosen, so any company that would like to be considered for inclusion should write to this magazine, marking the envelope (in the bottom left-hand corner) "Design Engineering Show."

#### Instrumentation symposium

The general theme of this symposium (to be held in Toronto in March) will be: "The nature and status of instrumentation in the Canadian aircraft industry."

An interesting program is being planned and papers are required for presentation during the two-day session. Each author will be permitted a 15-minute period for oral presentation of the highlights of his paper, to be followed by a question-and-answer period. No limit is placed on the length of the paper itself. The use of exhibits (where possible) is strongly encouraged.

This Canadian effort merits your full support!

*William Morse.*



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**JANUARY 1959**

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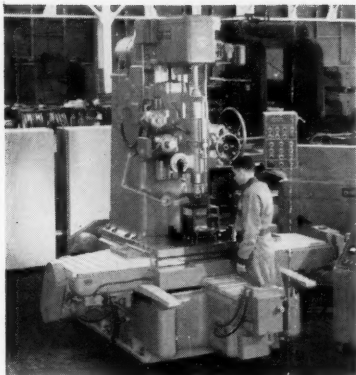
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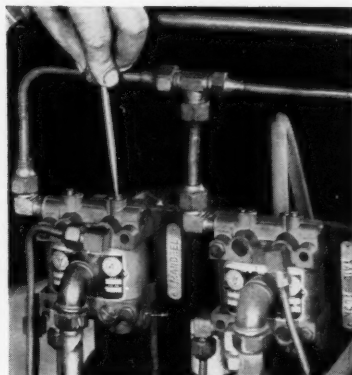
# Why Skinner 4-way solenoid valves are used so widely for cylinder control



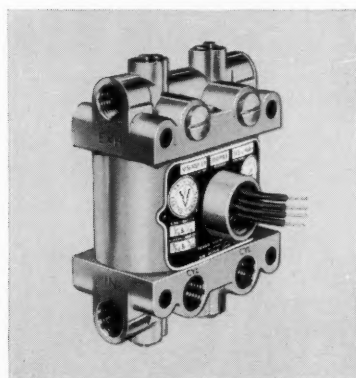
**Application:** A longitudinal and a transverse slide in this Pratt and Whitney Electro-Clamp Jig Borer is positioned automatically from numerical data on punched tape or manually by decade dials. When each slide has been correctly positioned it is held firmly by air-actuated, non-influencing clamps. Each clamp is controlled by a cylinder and a Skinner four-way V9 valve.



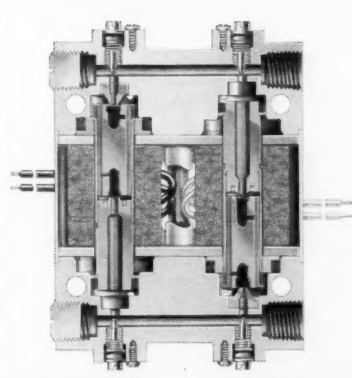
**Features of standard valve did job.** No special engineering of the four-way V9 valve was required to meet Pratt and Whitney's need. Molded oil-proof coils are used to guard against burnout from cutting solutions. The Skinner valve makes an ideal cross connection between electrical sensing and the muscular air required to provide the clamping action.



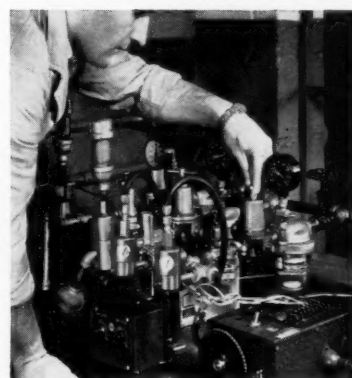
**Dependable cylinder control.** The four-way V9 valve is available with adjustable flow features in the main stream and in the exhaust passage for exceptionally accurate cylinder control. Position of inlet and exhaust connections can be changed easily in the field by simply reversing plugs.



**Skinner V9 four-way valves**, actually two 3-way valves in one housing are offered normally closed-normally open, normally open-normally open, and normally closed and normally open. Media: air, inert gases, hydraulic fluids and vacuum; orifices:  $\frac{3}{16}$ " to  $\frac{1}{8}$ "; NPT ports:  $\frac{1}{4}$ "; pressure ratings: to 250 psi. Over 350 basic variations.



**Quality workmanship throughout.** Internal parts are stainless steel and highly corrosion-resistant. Durable, compressible inserts of soft, synthetic materials insure bubbletight operation. Orifice seats have radius with well-rounded contact area and high finish for long insert life. Valve can be mounted in any position.



**Exceptional life expectancy.** Skinner valves, engineered to the highest UL standards, are life-cycled in the lab at speeds as high as 600 cycles per minute. In these tests, the V9 valves regularly get over 20-million cycles without leakage. And these results are constantly proving out in service.

Skinner has a wide selection of solenoid valves for all types of applications. If you have a control problem, please contact the following Skinner distributors or write us at the address below, Dept. 351.

**Cowper Co., Ltd.**

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**Dycon Limited**

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Toronto, Ontario

**C. M. Lovsted & Co., Ltd.**

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ment? Timken is your No. 1 bearing value. Wherever wheels and shafts turn, Timken bearings eliminate friction, cutting wear and maintenance to a minimum. Specify bearings trade-marked "Timken" for the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio, U.S.A. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".



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